VOL. 126 September 1961 NO. 9

MILITARY MEDICINE

ORIGINAL ARTICLES

Authors alone are responsible for opinions expressed in their contributions

Neuropathological Effects of Low-Level X-Irradiation of the Mammalian Embryo*

By

ROBERTS RUGH, Ph.D.† AND ERICA GRUPP

IT HAS recently been shown that the pre-implantation and predifferentiation mouse embryo is extremely vulnerable to ionizing radiations (x-rays) and that among the survivors there may appear congenital anomalies in addition to stunting, namely effects on the central nervous system (Rugh and Grupp '59, '60). It seemed urgent that a study be made of the cytological effects on the early cleavage stages after low levels of x-irradiation. Following is a report of the findings.

MATERIALS AND METHOD

CF1 Swiss white female mice were time-mated with males of the same strain by placing 2 males in a box containing five females at 5 P.M., and removing the males at 9 A.M. the following day. Each female was examined for the presence of a vaginal plug, a certain sign of successful copulation but not necessarily of fertilization, although this is usually the result. Since copulation could occur at any time between 5 P.M. and 9 A.M. the next morning, although it seems that mating most frequently occurs around midnight, there was a possible 16 hour span in fertilization time. In any case, those found at 9 A.M. to have vaginal plugs were presumed to have mated ½ day previously (12 ± hours). The first cleavage takes place in from 24-36 hours after insemination. It was planned to irradiate the eggs at about the time of the first cleavage, hence at 1.5 days after insemination or at about 9 A.M. the second morning after mating. Others were irradiated at 2.5 days or between the 4 and 8 cell stages. The results of this study indicate that exposure of the first group occurred at both the one and the two-cell stages, sometimes both stages being present within the same oviduct.

X-radiation was supplied by a single tube at 89 centimeters from the level of the uterus, at 184 KVP, 30 MA, filtration 0.28 mm. Cu and 0.50 mm. Al filters, HVL 0.6 mm. Cu, and a dose in air at the level of the uterus of 15 r per minute. Extrapolation to rads gives a figure less than 3% from that estimated in roentgens. It was found, with phantom and Victoreen readings, under the conditions of dosimetry and scattering involved, that the actual delivered dose was 14.8 rads at the position of the embryos, hence 1.3% less than calculated, and certainly beyond the limits of biological detection. This error, if it can be so regarded, is in the direction of greater significance because it means that actually the embryos received, if anything, less than the planned

* Based on work performed under Contract AT-30-1-GEN-70 for the Atomic Energy Commission and aided by PH Grant B-2116 (C2).

From Radiological Research Laboratory, Columbia University, New York.

† Associate Professor of Radiology.

TABLE 1

	Controls	Experimentals
Age of Embryos	1.5 days	1.5 days
Stage of Development	1-2 cells	1-2 cells
X-Irradiation Exposure	0	15 r
Total Pregnancies	61	13
Total Implantation Sites	630	127
Total Normals	591 (94%)	112 (88%)*
Total Exencephalies	0	3 (2.3%)
Total Resorptions	37 (5.7%)	11 (9%)
Total Dead	2 (0.3%)	1 (0.7%)

* Note: A 6% reduction in "apparent normals," which may also include some abnormals. This 6% probably represents embryonic loss at the very early stages described.

15 rads of x-rays. Following exposure the pregnant mice were treated exactly as were the pregnant controls, maintained in our animal room at 72°F., with air conditioning, adequate food and water.

At each interval of 2, 24, and 72 hours after x-irradiation, three females were sacrificed by cervical dislocation and their entire reproductive tracts were quickly removed and fixed in Bouin's fluid. The entire oviduct and uterus was sectioned longitudinally and serially at 6 microns, stained with Harris' haematoxylin without benefit of any counterstain, and searched for mouse embryos at the early stages of development. These were generally found in close approximation in the upper oviduct, enroute to the uterus. In addition to the above, thirteen pregnancies were allowed to progress and were terminated at 17.5 days gestation for a study of the gross congenital effects of 15 r exposure at the previous 1-2 cell stage.

EXPERIMENTAL DATA

In a previous report (Rugh & Grupp '60) it was shown that 15 r at 1.5 days post-conception did in fact increase the intrauterine death and resorption, and did produce exencephalies. These data are summarized in Table 1. Among mice which reach the critical stage of implantation at 4.5 days, some will still fail and be resorbed even among the controls but this number is increased (to 9%) by exposure to 15 r at 1.5 days post conception. It would be difficult to determine the number which fail to reach the stage of implantation, since they would leave no implantation sites. Nevertheless, it is apparent from this study that there is probably some loss of embryos at earlier stages, most certainly as a result of 15 r x-ray exposure.

Cytologically the most common effect of x-irradiation is the fragmentation of the early cleavage stage, so that instead of a large pair of ovoid blastomeres at the 2-cell stage (Fig. 1) one finds spherical masses of cytoplasm which may or may not contain germinal vesicles, zygotic nuclei, or even nuclei of early blastomeres, (Figs. 2-15). Sometimes the nuclei are swollen, sometimes pyknotic, and generally the outline of the cytoplasm is indistinct. However, while cytoplasmic globules may be fragmented off from the blastomere, often the remaining portion of the blastomere seems to round out to appear to be a topographically complete but reduced cell with distinct nucleus (Figs. 2-5). Sometimes the nucleus is contained within one of the fragments (Figs. 9-15). It is difficult to imagine that any of these might function, and it must be emphasized that these anomalies are produced within 2 hours of exposure, but do not involve a high percentage of the developing eggs. It is impossible to give statistical data here, but these eggs fragmented by 15 r probably number considerably less than 20% of all fertilized eggs. Such anomalies have not been found in the controls.

Early embryos examined 24 hours after exposure to 15 r at 1.5 days post-conception still may show fragmentation (Figs. 18-22, 24-26) but the fragments resemble more discrete blastomeres rather than cytoplasmic globules. The more prominent feature at this time is the separation of the blastomeres, pyknosis of the nuclei, and slight hyperchromaticity of the cytoplasm. This latter condition is probably related to necrosis (Figs. 18-26, especially 22-24). When the blastomeres are separated and somewhat disintegrated, there seems to exude from them a sticky substance previously seen in invertebrate eggs which have been irradiated (Rugh '53). This stickiness, following x-irradiation, has also been seen in the meiotic chromosomes of maturation stages of spermatogenesis (Rugh '50). It may well represent a breakdown step in protein degeneration due to irradiation.

If one examines mouse embryos, exposed to 15 r at 1.5 days, but studied some 3 days later (at 4.5 days) when implantation occurs, one sees that some of them survive the exposure only to show degenerative changes at this time (Figs. 29-34). Normally implantation is clean (Fig. 28) but in some x-irradiated embryos there may be delay in development (Fig. 29), distortion due to cellular damage (Figs. 30, 31), complete separation of cells (Fig. 32), swelling of some cells (Fig. 33), or the appearance of giant cells with multiple sets of chromosomes (Fig. 34). Whether some of these embryos could survive, if implanted, is pure conjecture since it would be impossible to follow specific individuals. Certainly such embryos as do survive may well carry with them developmental anomalies which later may be seen as stunted fetuses and anencephalies (Fig. 35), or severe exencephalics (Fig. 36), none of which would survive long after delivery.

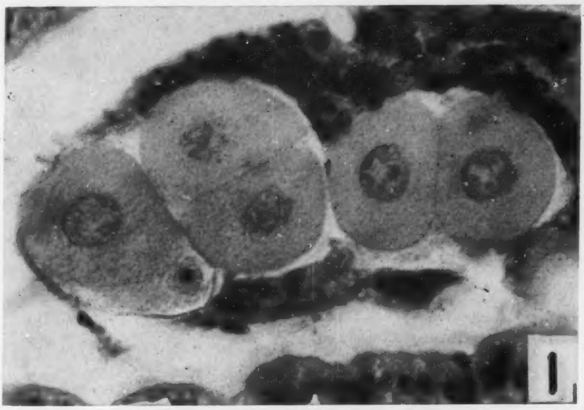


FIG. 1. One and two cell stage normal mouse embryos in oviduct 1.5 days after conception. Note persistent polar body. (From Rugh & Grupp, J. Exp. Zool., 141:571, 1959.)

It is believed that the older the embryo the more radio-resistant it becomes. There is certainly evidence that the very early embryo is extremely radiosensitive, since 5 r (Rugh and Grupp '59) and 15 r produce statistically valid increases in intra-uterine deaths. If one exposed the mouse embryo at 2.5 days (4 cell stage) to 15 r, some damaging, as well as lethal effects, can be demonstrated. Again it must be emphasized that statistical data are not available, but the effects illustrated are rarely if ever seen in normal, unirradiated uteri. The irradiated embryo at 2.5 days (Fig. 37) should reach the late blastula stage (Fig. 38) by 3.5 days, and these embryos will be found equidistant

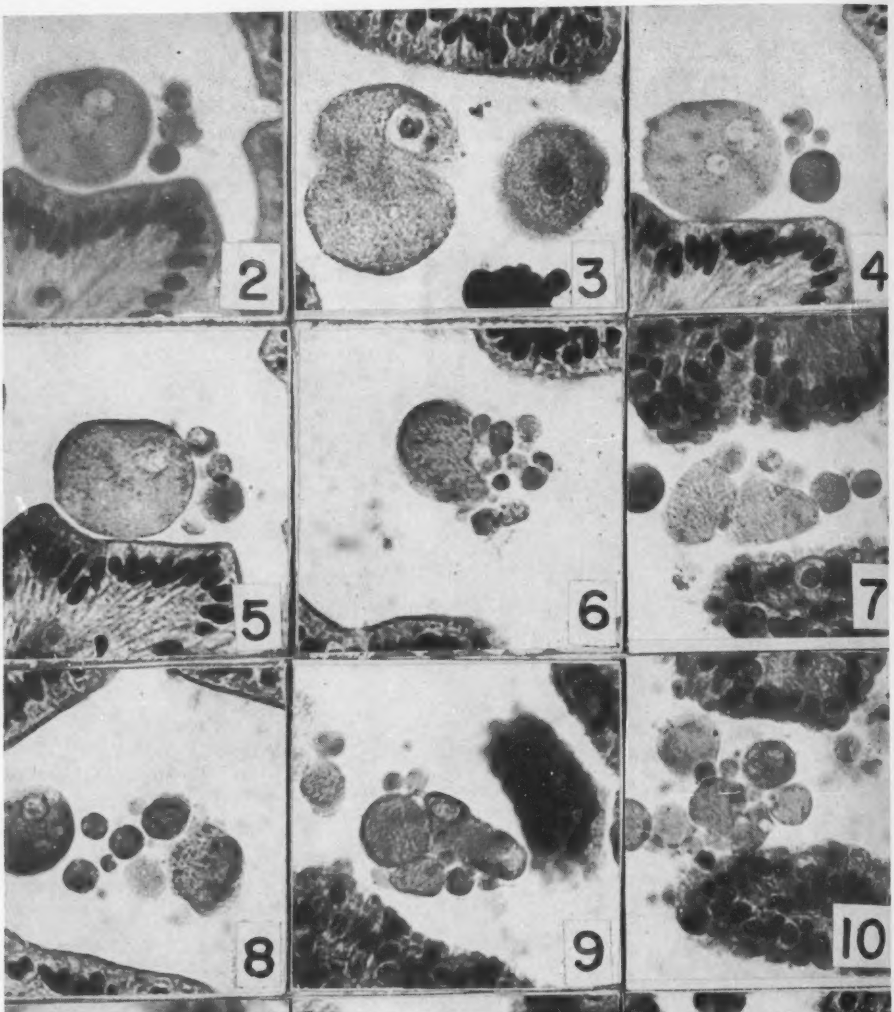
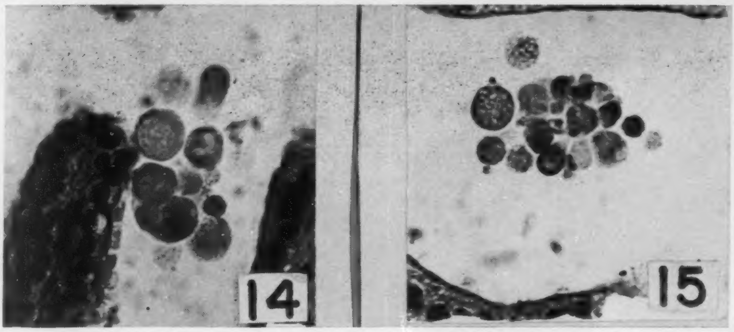


PLATE I

(Explanation of figures given on facing page)



FIGS. 14 and 15. Continuation of effects of 15 r x-rays at 1.5 days after fertilization: mouse. These two figures probably represent two cell stage disintegration.

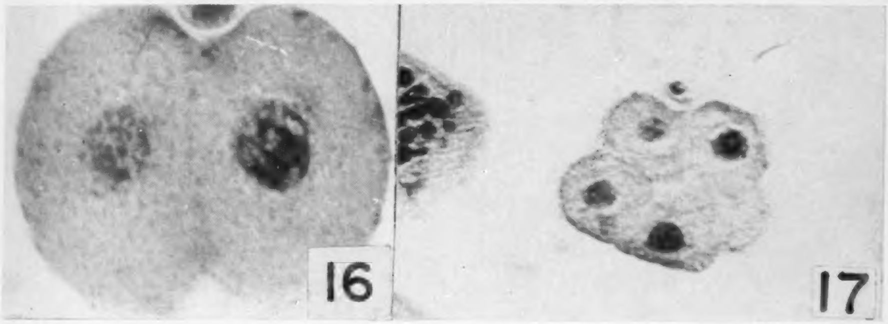


FIG. 16. Normal mouse embryo at 1.5 days development, generally in 1-2 cell stage. (This is a slightly enlarged photo).

FIG. 17. Normal mouse embryo 24 hours after stage shown in figure 16, or about the 4-8 cell stage. This embryo shows persistent polar body.

apart in the uterus (Fig. 39). However, such irradiation can destroy this stage of development (Figs. 40, 41, 43, 44, 47), can cause pyknosis of the nuclei (Figs. 42, 45, 47-51), can produce giant cells (Figs. 46, 50) and the clumping of chromosomes (Fig. 47). Some of these blastulae have minor damage (Figs. 45, 49, 51) but this may be sufficient to cause the fetus to develop congenital anomalies of a gross nature.

Finally, exposure to 15 r at 2.5 days (Fig. 52) may result in survival to the onset of organogenesis (Figs. 61-64). But such exposure may kill during the process of implantation or organogenesis (Figs. 55-60). These figures (55-64) should be compared with the normally expected development as shown in figures 53 and 54. Such dead or

---

FIG. 2-13, incl. (Plate I). Effect of 15 r x-rays at 1.5 days after fertilization: mouse.

FIGS. 2, 4, and 5. Effect of 15 r x-rays on stage as shown in figure 1; as seen after 2 hours. Note male and female pronuclei, and extruded cytoplasmic masses, and one polar body (5).

FIG. 3. Congealed, pyknotic nucleus of one blastomere of two-cell stage. Note hyperchromatic nucleus of isolated cell.

FIGS. 6-13, incl. Various stages of disintegration of the early cleavage of the mouse egg, following 15 r x-rays. Note that the pronuclei are sometimes in extruded mass (9, 13), and sometimes in the remaining portion of the egg (8, 11).

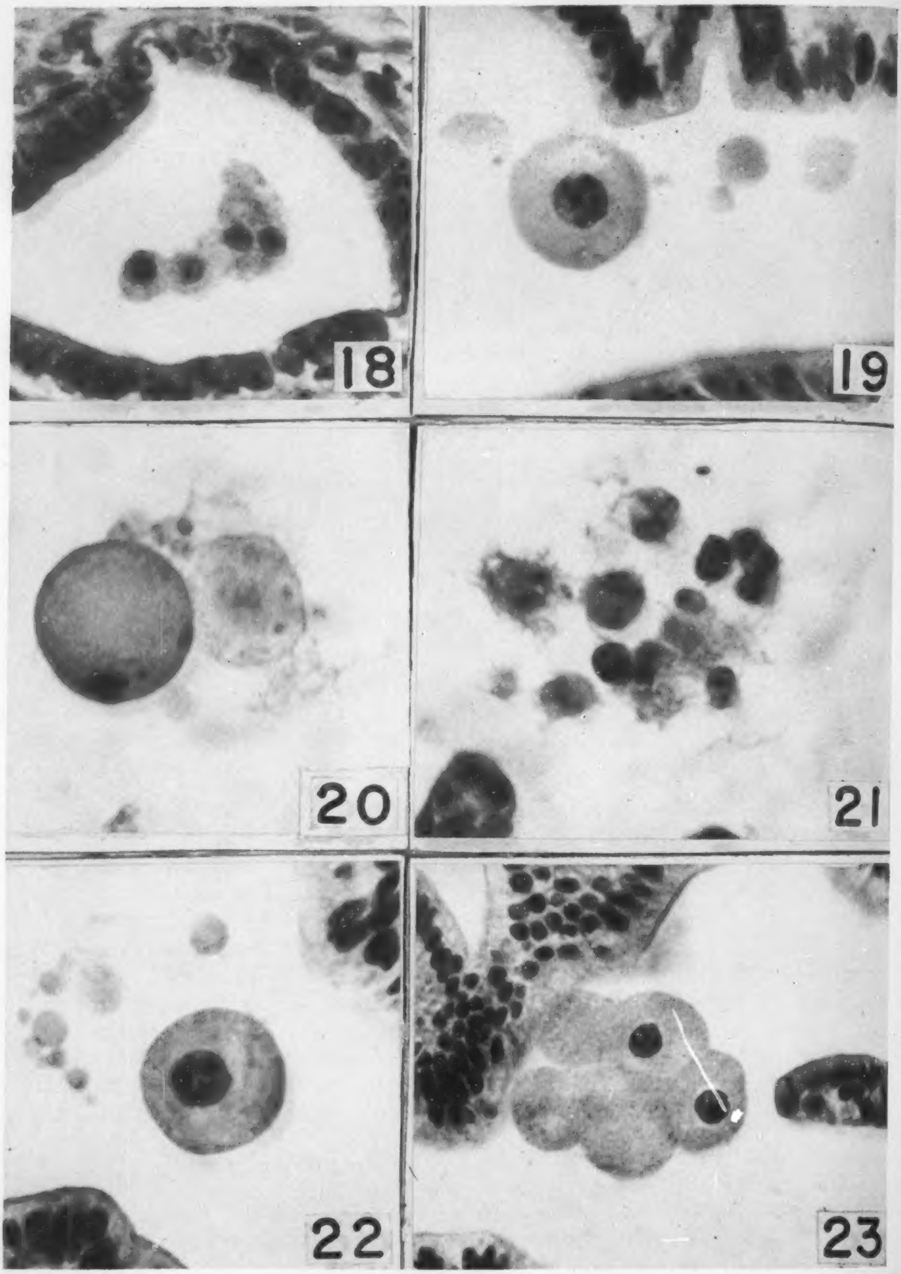
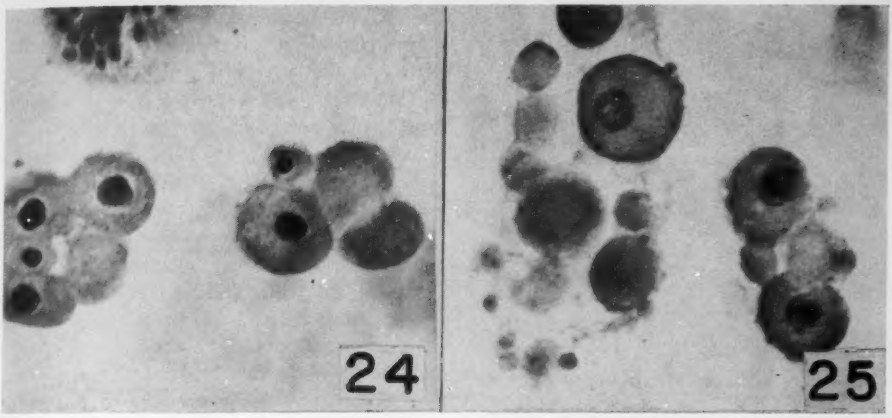


PLATE II

(Explanation of figures given on facing page)



FIGS. 24 and 25. Continuation of studies of effect of 15 r x-rays at 1.5 days after fertilization. As seen 24 hours later.

FIG. 24. Abnormal nuclei, both in staining quality and Size.

FIG. 25. Disorganized 4-8 cell stages (2) showing staining affinity of dead cells.

dying embryos would remain as resorption sites at 18.5 days gestation, and would be included in the statistics of Table 1.

DISCUSSION

The pioneer studies of the x-irradiation effects on the mouse embryo were made by Russell ('50-'57) who stated a number of times that x-irradiation with 200 r before implantation (0.5 to 4.5 days post conception) increased the prenatal mortality in the early stages, but 100% of those which survived to term were "normal" with respect to their external characters. Otis and Brent ('52) confirmed these findings and stated further that the greatest prenatal loss was sustained in semi-steriles after 600 r x-rays were delivered at the implantation period, and that after implantation the chromosome imbalance often resulted in anomalies of the central nervous system which was seen as either open, everted, or collapsed in many embryos. Hicks ('52, '54) stated that the nervous system of the rat embryo was unaffected by exposures up to 300 r x-rays during the first 8 days of gestation, but a sharp change occurred about the ninth day and the embryo became very susceptible to CNS anomaly development. This "all-or-none" effect with respect to x-irradiation of the pre-implantation embryo seems to be true only at the higher levels of x-irradiation (200 r or more). It is now admitted that at certain stages in development even the human embryo might be affected by as little as 25 r (Russell & Russell '56). Further, the statement that the survivors of 200 r or more x-irradiation are "normal" should be challenged because, when compared with proper controls, they are invariably stunted.

FIGS. 18-23, incl. (Plate II). Effect of 15 r x-rays at 1.5 days after fertilization (mouse). As seen 24 hours later.

FIG. 18. Disorganized four-cell stage, with pyknotic nuclei, due to 15 r x-rays.

FIG. 19. Reduced cell, uncleaved, with extruded cytoplasmic masses and hyperchromatic nucleus.

FIG. 20. Both cytoplasm and nuclei hyperchromatic, and extruded vesicular cytoplasm.

FIG. 21. Completely disorganized 4-8 cell stage.

FIG. 22. Hyperchromatic nucleus with extruded cytoplasmic vesicles.

FIG. 23. Apparently normal cleavage to 4-8 cell stage but hyperchromatic nuclei.

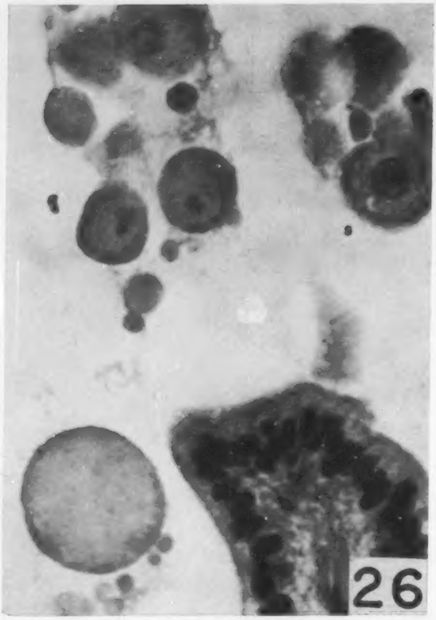


FIG. 26. Three different embryos showing grades of disintegration, following 15 r x-rays 24 hours previously at 1.5 days (2-4 cell stage).

The earlier ideas of a "critical period" of radio-sensitivity as measured by effects on specific organs, must be abandoned because CNS anomalies have been produced by exposure many days prior to the beginning of neurogenesis (Rugh & Grupp '59, '60). Further, the idea of an "all-or-none" reaction may apply to a high level lethal dose, but certainly does not apply to low levels as used in these experiments. When one gets effects such as a severe CNS exencephalia following 15 r, it must be admitted that possibly there is no level of exposure without some effect on the very early embryo.

The first noticeable effect of x-irradiation of the mouse egg is a delay in cleavage. This has been reported previously for the Arbacia egg (Henshaw '33, '40, '41; Henshaw & Francis '46) and later confirmed by Rugh ('58). It was shown in the latter study that the so-called "recovery" phenomenon, which was evident when fertilization was delayed after x-irradiation, was not true recovery from irradiation damage but a recovery only of the cleavage rate or time. Nevertheless, irradiation did delay the time of the early cleavages and this appears likewise to be true for the mouse egg, even with an exposure of 15 r at the 1-2 cell stage. This cannot be stated statistically but the rarity of the 2 cell stage in irradiated animals compared with the control animals at 1.5 days after conception tends to support this statement.

The second noticeable effect is the fragmentation of what appears to be very sensitive cytoplasm of the uncleaved but fertilized egg. Accompanying this fragmentation, both the nucleus and the cytoplasm become hyperchromatic, and in the more damaged cells, the nucleus becomes pyknotic. Of course the above mentioned cleavage delay might be a corollary of these cytoplasmic and nuclear changes, since they could certainly affect the cleavage mechanism. In some instances the cytoplasm appears to have a lesser affinity for stains, while invariably the nucleus is hyperchromatic.

FIGS. 27-33, incl. (Plate III).

FIG. 27. Normal mouse embryo at 1.5 days, showing both 1 and 2 cell stages with vesicular nuclei. (Slightly enlarged photo).

FIG. 28. Normal mouse embryo at time of implantation at 4.5 days.

FIGS. 29-34. Effect of 15 r x-rays at 1.5 days after fertilization. These should all be at the stage of development comparable to that of Fig. 28.

FIG. 29. Note pyknotic nuclei.

FIGS. 30 and 31. Note reduced blastulae with pyknotic nuclei, and karyorrhexis (30).

FIG. 32. Completely disintegrated blastula.

FIG. 33. Note vacuolated cytoplasm in endoderm cell near inner cell mass, and pyknotic nuclei. (Enlarged photo).

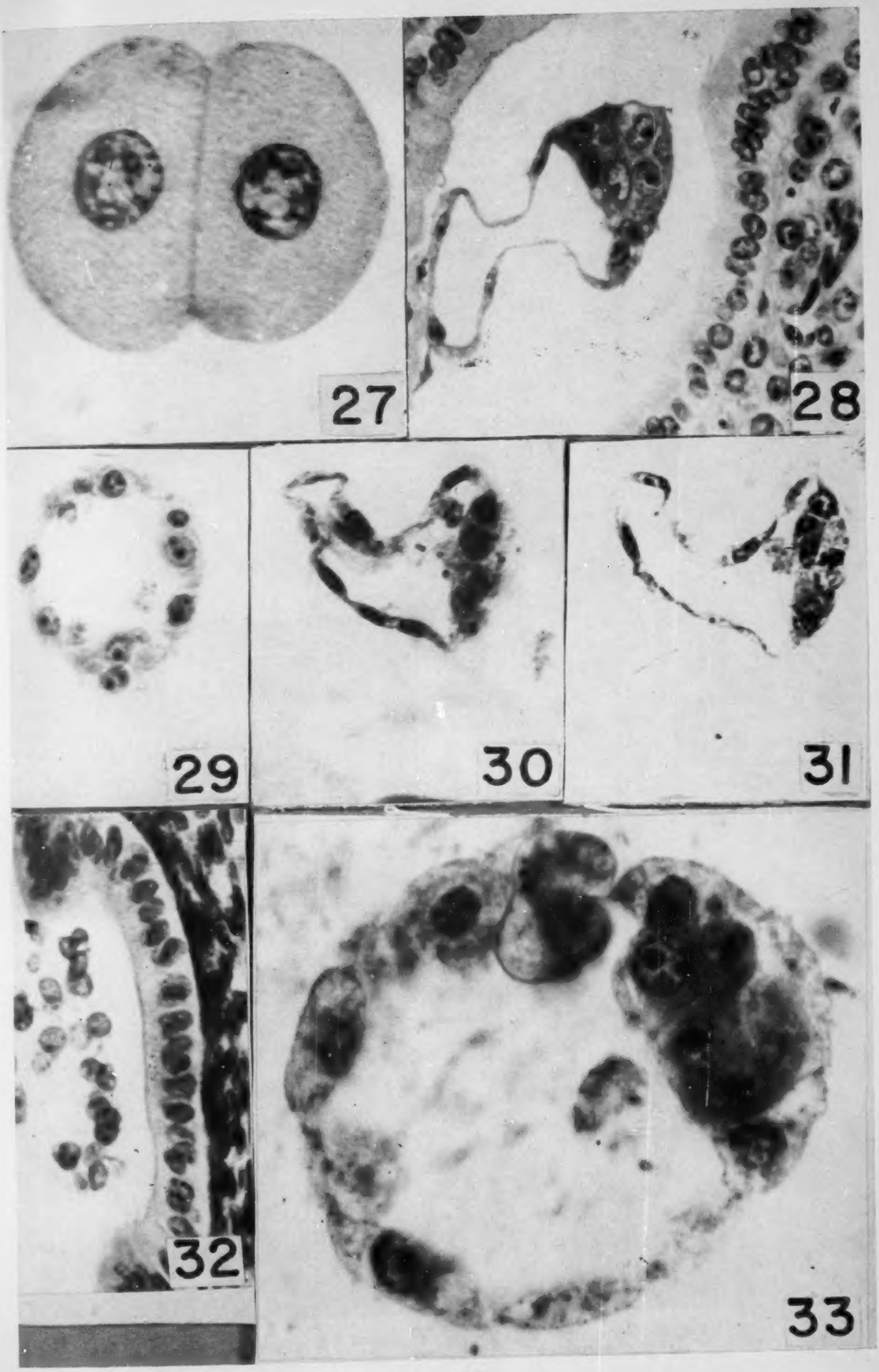


PLATE III

(Explanation of figures given on facing page)

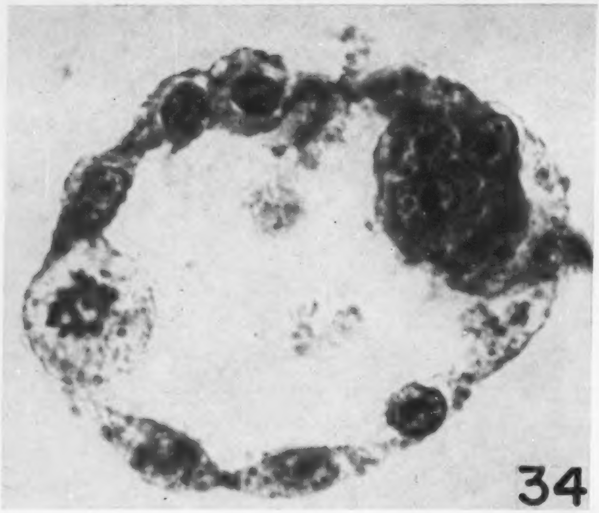


FIG. 34. Effect of 15 r x-rays at 1.5 days after fertilization. Note giant cell with chromosomes in trophectoderm with other cells having pyknotic nuclei. (Enlarged photo.)

FIG. 35. Three members of a litter which had received 15 r at stage comparable to figure 27 (Plate III), but were allowed to develop to day 17.5. Note variations in size from stunted to almost normal, with intermediate individual having herniated brain.

FIG. 36. Four members of litter exposed at 1.5 days to 15 r showing one pronounced exencephaly at 17.5 days development. The other litter members were slightly stunted but otherwise "appeared" normal.

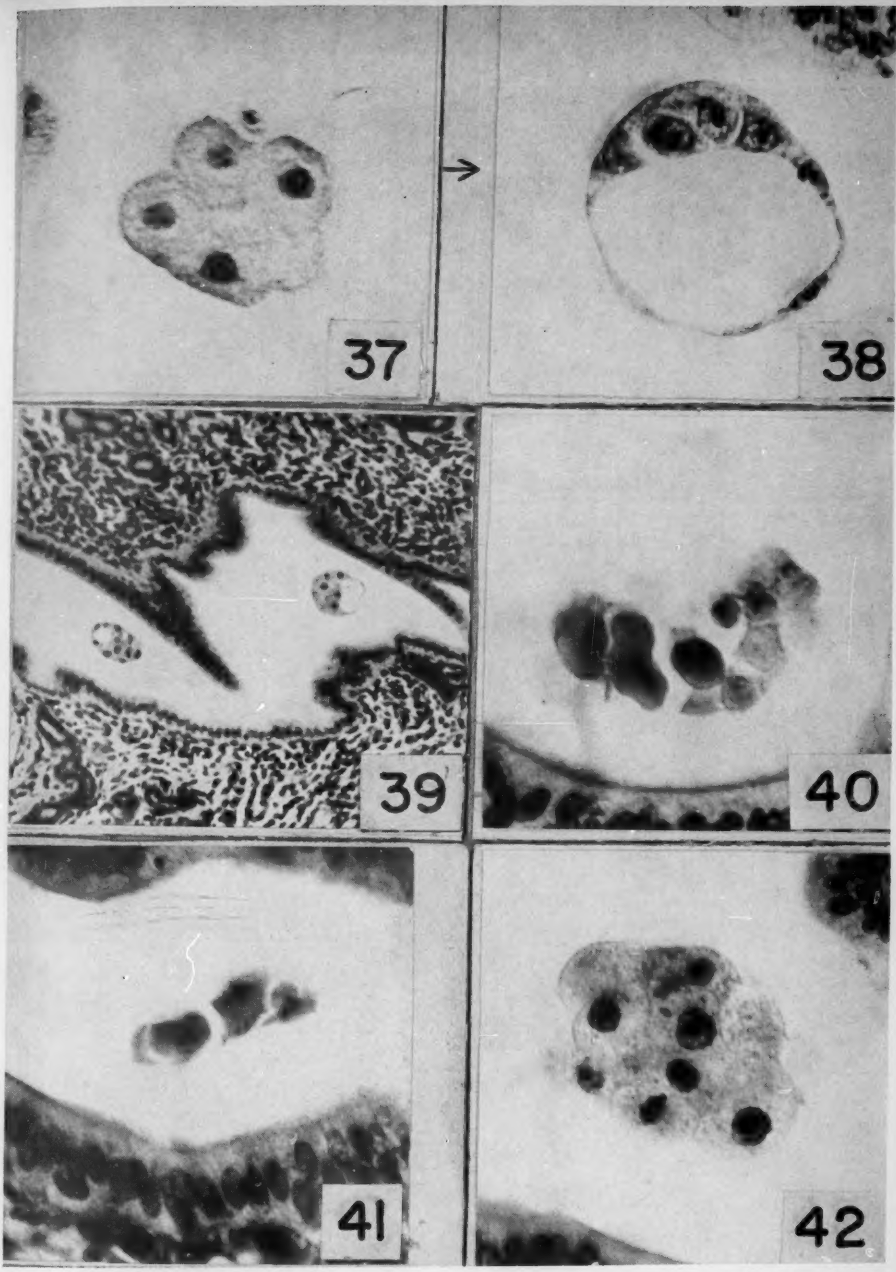


Plate IV

Figs. 37-42, incl. (Plate IV).

Fig. 37. Normal mouse embryo at 2.5 days after fertilization, at 4-8 cell stage.

Fig. 38. Normal development at 3.5 days stage at which figures 39-51 should be.

Fig. 39. Uterus with two irradiated embryos prior to implantation. Irradiation—15 r x-rays at 2.5 days. Mouse development at 3.5 days.

Fig. 40 and 41. Disintegrating early cleavage stages following 15 r exposure.

Fig. 42. Delayed cleavages (blastulas) showing indistinct cell boundaries and hyperchromic nuclei. (15 r x-ray exposure).

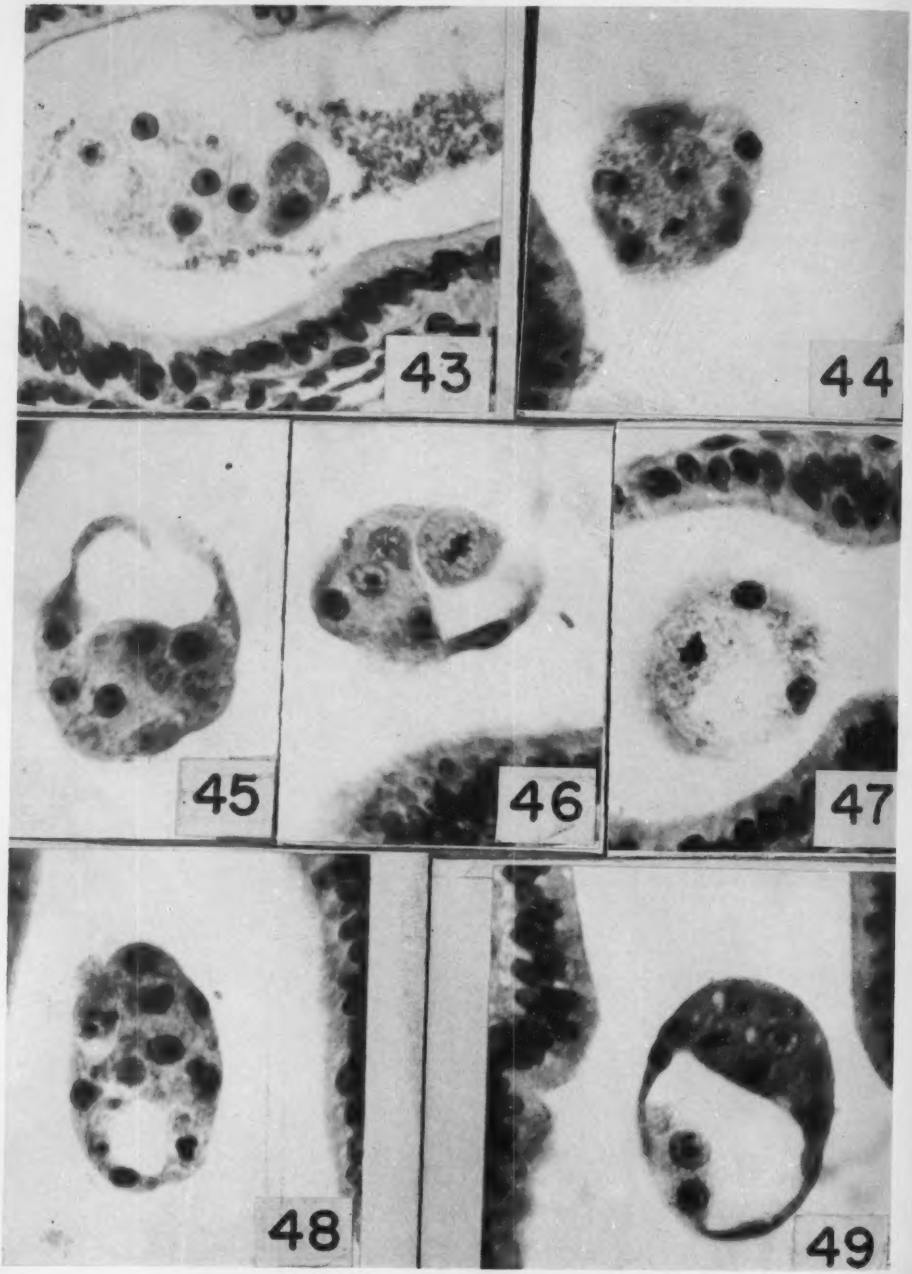
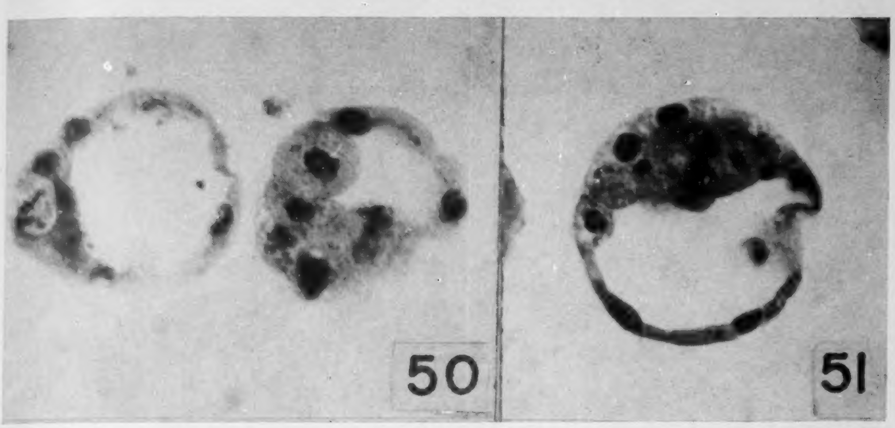


PLATE V

(Explanation of figures given on facing page)



FIGS. 50 and 51. Continuation of Plate V, effect of 15 r x-rays at 2.5 days, mouse development seen at 3.5 days. Aberrant chromosomes (fig. 50), and many congealed and pyknotic nuclei.

In the later stages of necrosis (degeneration) the cytoplasm appears to burst forth through the cell membrane, and is found as a sticky mass which does not readily stain. This condition was earlier described (Rugh '53) in invertebrate eggs and probably represents a drastic chemical change in the protein constituents of the cytoplasm.

Other changes noted during early development include the formation of giant cells which appear also to have an excess of chromatin material. Giant cells appear in adult tissues of vertebrate organisms following x-irradiation, particularly in those tissues where regeneration is likely to be rapid. Also, one notes vacuolization and edematous swelling of cells, all of which characteristics are well known in adult radio-pathology.

Certainly some, if not many, of the early embryos exposed to 15 r die and are resorbed prior to the time of implantation so that there is no implantation site residue to identify them. How many of these occur it would be virtually impossible to determine. Death and resorption after the time of implantation results in a hemorrhagic residue which can be identified. However, some irradiated and damaged early embryos are able to reconstitute themselves into a topographically rather normal whole and come

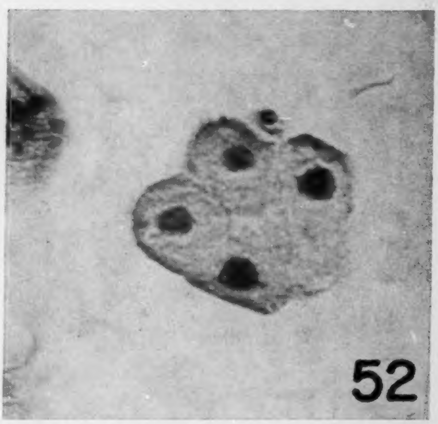


FIG. 52. Normal 4-8 cell stage at 2.5 days after conception.

FIGS. 43 and 49, incl. (Plate V). Effect of 15 r x-rays at 2.5 days, mouse development seen at 3.5 days.

FIGS. 43 and 44. Delayed cleavages (blastulas) showing indistinct cell boundaries and hyperchromic nuclei.

FIGS. 45-49. Development only slightly delayed (compare with fig. 38, Plate IV), but showing giant cells (fig. 46), congealed and pyknotic nuclei.

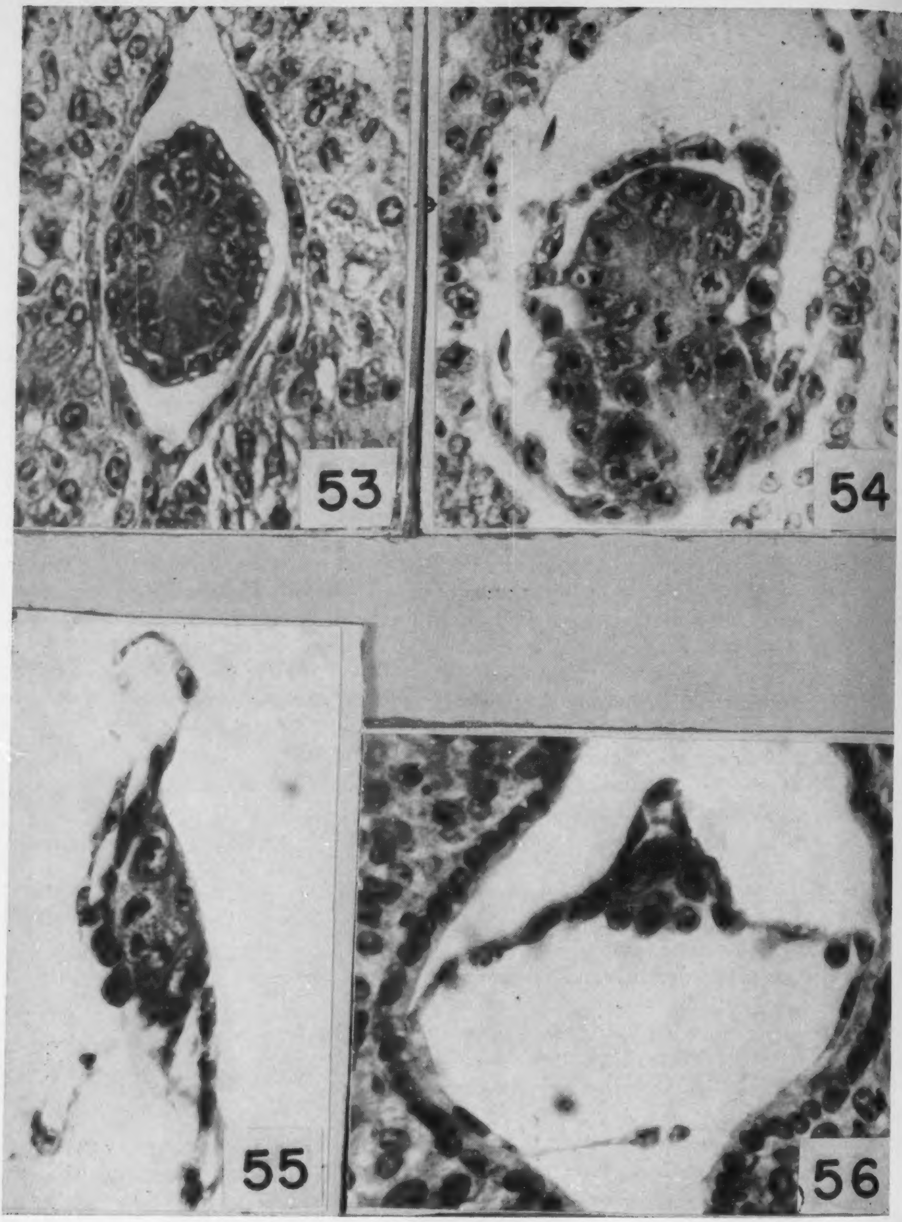


PLATE VI

FIGS. 53-56. incl. Plate VI.

FIGS. 53 and 54. Normal development as seen at 5.5 days, 3 days after stage shown in fig. 52.

FIG. 55. Effect of 15 r x-rays at 2.5 days: as seen at 5.5 days. Much retarded and distorted embryo, at least 24 hours behind the controls (figs. 53 or 54).

FIG. 56. (See also fig. 57, Plate VII). Both figs. 56 and 57 show same embryo at different levels, showing much retarded development following radiation of 15 r x-rays given at 2.5 days and seen at 5.5 days.

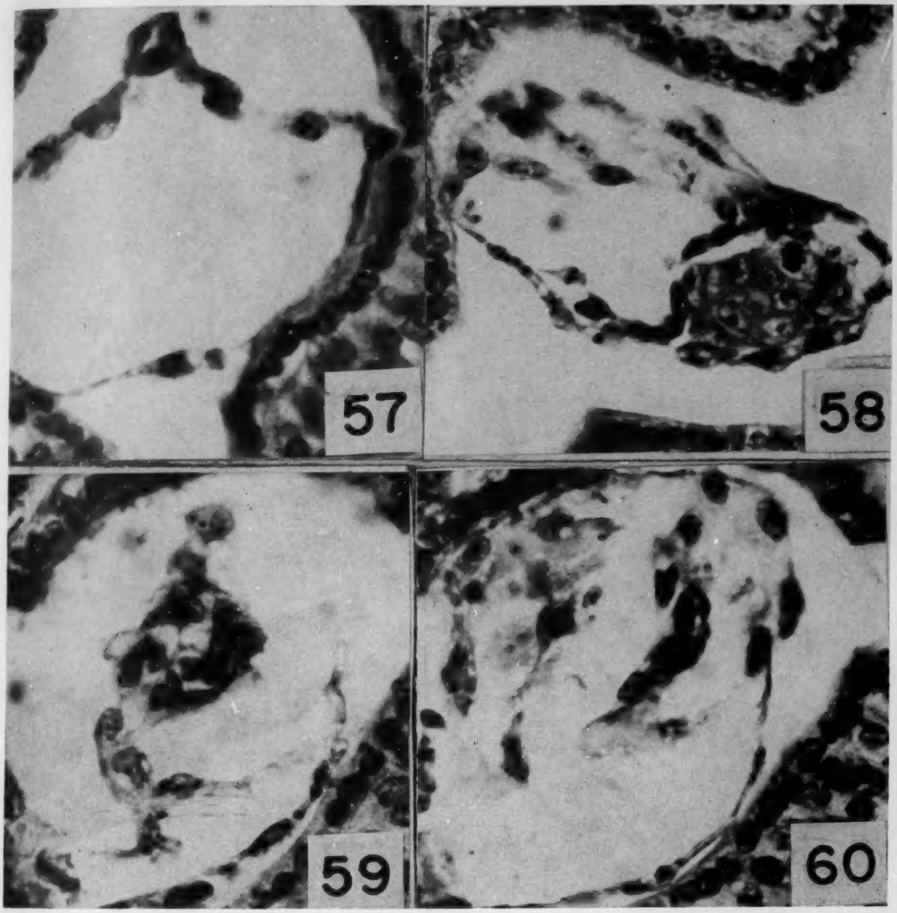


PLATE VII

FIGS. 57-60, incl. (Plate VII). Effect of 15 r x-rays at 2.5 days: as seen at 5.5 days.

FIG. 57. (See also fig. 56, Plate VI). Figs. 56 and 57 are of the same embryo at different levels, showing much retarded development. Delay in development seen by comparison with figs. 53 and 54.

FIGS. 58, 59 and 60. Implantation stages disintegrating, three days after 15 r.

to term, only to exhibit congenital anomalies that may kill them shortly after birth, such as the exencephalies exhibited. Stunting is over-all reduction in volume, and that is often overlooked unless one compares a proper control with the x-irradiated fetus, since the latter is topographically quite normal. It is these "apparently normal" but x-ray stunted individuals which may cause social, psychological, and other problems among the humans, due to deficiencies in the normal cortical requisites of the C.N.S.

Exposures at 2.5 days do result in the same types of anomalies and some intra-uterine deaths, but to a lesser degree than similar exposures at earlier stages. Here there appears to be less fragmentation but a higher level of death and resorption at the time of implantation. This is, no doubt, one of the most critical stages in normal development so that any inherent anomaly, due to chromosome aberrations in constituent

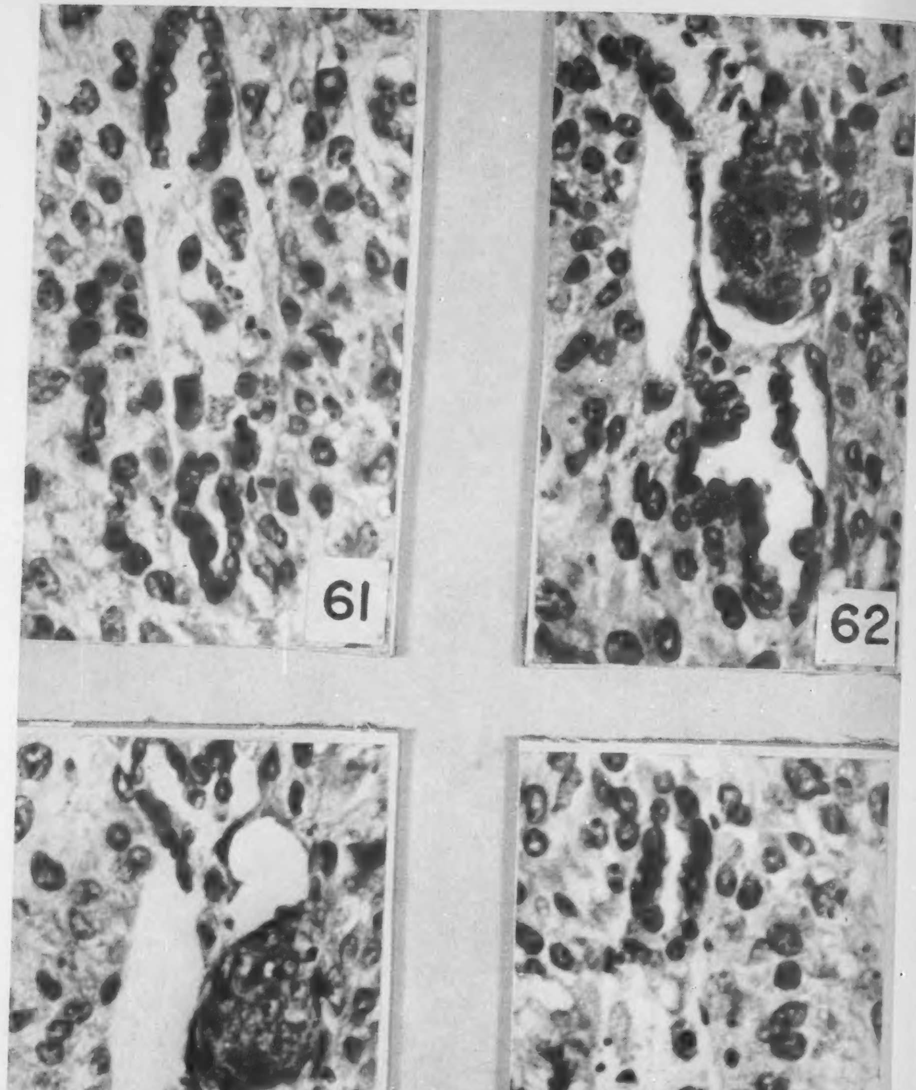


PLATE VIII

(Explanation of figures given on facing page)

cells, might well express itself. Surviving implantation, the anomalies are likely to reach delivery, but, in the mouse, offspring with gross congenital anomalies are generally destroyed by the mother. The subtle deficiencies following embryonic x-irradiation will have to be revealed by behaviour, E.E.G., and other highly refined tests that show changes not seen on the pathological slide.

It is believed that the reactions of the early mouse embryo to ionizing radiations are basically similar to those of any vertebrate embryo. However, it is impossible to extrapolate to the human where we might find the embryo to be more, or even less, radiosensitive than the mouse. All that can be done is to take the suggestion that the earlier the stage of development the more radiosensitive, the more intra-uterine death, and those which survive irradiation may develop congenital anomalies. Since the level of exposure used in these experiments comes within the range of some diagnostic procedures for the human pelvis, it is obvious that the clinician must be absolutely certain there is no possible early pregnancy before making such a radiological diagnosis. In fact, the very early embryo may be as radiosensitive as the gene and any x-irradiation should be considered as unsafe and too much. With each further investigation the results appear to point in this direction. It is also obvious from such a study that "the embryo" is such a dynamic and ever-changing biological unit that a generalization about its radiosensitivity is impossible. Nevertheless, it is so radioresponsive in its early stages that, in addition to basic embryological findings, it is a very sensitive dosimeter for ionizing radiation.

Summary and Conclusions

1. An exposure of the 1.5 day mouse embryo (at the 1-2 cell stage) to as little as 15 r x-rays will delay the early cleavages, increase intra-uterine death and resorption, reduce the number of "apparently normals" at birth, and occasionally cause the severe brain anomaly of exencephalia (brain hernia) indicating morphogenetic damage.
2. When the embryo at 2.5 days (4-8 cells) is exposed to the same low level of 15 r x-rays there is less severe damage, and exencephalia has never been produced. However, even some of these embryos go to pieces shortly after exposure or at the time of implantation.
3. Cytologically the most common effect on some embryos of 15 r at 1.5 days is fragmentation of the early cleavages, resulting in reduced and a-nucleate blastomeres. Whether such a reduced but nucleated blastomere could give rise to a stunted fetus is mere conjecture.
4. Other effects of 15 r at 1.5 days are swollen or pyknotic nuclei, hyperchromatic nuclei and occasionally the cytoplasm, and sometimes complete separation of constituent cells of the blastula at a later stage. Damaged blastomeres appear to exude a sticky substance which may be denatured cytoplasmic protein.
5. Radiosensitivity of the embryo appears to be greatest immediately after fertilization and becomes progressively less as development proceeds. Until organogenesis is completed, however, embryonic loss may occur through death and resorption as a result of x-irradiation and among the others there may be congenital anomalies and stunting which survive delivery.
6. While extrapolation to other mammals is ill-advised, it is certainly suggestive that the radiosensitivity of the very early mammalian embryo may approach

FIGS. 61-64, incl. (Plate VIII). Post implantation stages of mouse embryo exposed at 2.5 days to 15 r x-rays and examined three days later at which time they should all have appeared as in figures 53 and 54. Note various degrees of disintegration and dissolution, with invading macrophages.

that of a genic mutation,* and any exposure is too much.

REFERENCES

Henshaw, P. S.: "The effect of roentgen rays on the time of the first cleavage in marine invertebrate eggs. II. Differential recovery and its influence when different methods of exposure are used." Radiology 21:533-541 (1933).

Henshaw, P. S.: "Further studies on the action of roentgen rays on the gametes of Arbacia punctulata." Am. J. Roentgen. Rad. Therapy 43:899-933 (1940).

Henshaw, P. S.: "The induction of multipolar cell division with x-rays and its possible significance." Radiology 36:717-724 (1941).

Henshaw, P. S. and Francis, D. S.: "The effect of x-rays on cleavage of Arbacia eggs; evidence of nuclear control of division rate." Biol. Bull. 70: 28-35 (1936).

Hicks, S. P.: "Some effects of ionizing radiations and metabolic inhibition on the developing mammalian nervous system." Jour. Pediatrics 40:489-513 (1952).

Hicks, S. P.: "Developmental malformations produced by radiation: A timetable of their development." Am. J. Roentgen. Rad. Ther. & Nucl. Med. 69:272-293 (1953). (See also AECU-2264, 1952).

Hicks, S. P.: "Effects of ionizing radiations on the adult and embryonic nervous systems." Metab. and Toxic Diseases of Nervous System 32:439-462 (1953) (also see AECU-2480, 1953).

Hicks, S. P.: "Mechanism of radiation anencephaly, anophthalmia, and pituitary anomalies, repair in the mammalian embryo." Arch. Path. 57:363-378 (1954).

Otis, E. M. and Brent, R.: "Equivalent ages in mouse and human embryos." UR-194 (1952).

Rugh, R.: "The immediate and delayed morphological effects of x-irradiation on meiotic chromosomes." Jour. Cell. & Comp. Physiol. 36:185-203 (1950).

Rugh, R.: "The x-irradiation at different levels on the germ cells of the clam, Spisula." Bull. 104:197-209 (1953).

Rugh, R.: "The so-called 'recovery' phenomenon and 'protection' against x-irradiation at the cellular level." Biol. Bull. 114:385-393 (1958).

Rugh, R. and Grupp, E.: "X-irradiation exencephaly." Am. J. Roentgen. Rad. Ther. & Nucl. Med. 81:1026-1052 (1959).

Rugh, R.: "The x-irradiation of marine gametes: A study of the effects of x-irradiation on the germ cells of the clam, Spisula." Bull. 104:197-209 (1953).

Rugh, R.: "Ionizing radiations: Their possible relation to the etiology of some congenital anomalies and human disorders." Military Med. 124:401-416 (1959).

Rugh, R. and Grupp, E.: "Ionizing radiations and congenital anomalies in vertebrate embryos." Acta Emb. and Morph. Exp. 2:257-268 (1959).

Rugh, R. and Grupp, E.: "Responses of the very early mouse embryo to low levels of ionizing radiations." Jour. Exp. Zool. 141:571-588 (1960).

Russell, L. B.: "X-ray induced development abnormalities in the mouse and their use in the analysis of embryonic patterns. I. External and gross visceral changes." Jour. Exp. Zool. 114: 545-602 (1950).

Russell, L. B.: "The effects of radiation on mammalian prenatal development." *Radiation Biol.* 1:861-918, Ed. A. Hollander, Pub. McGraw-Hill Book Co., New York (1954).

Russell, L. B.: "Effects of low doses of x-ray on embryonic development in the mouse." Proc. Soc. Exp. Biol. & Med. 95:174-178 (1957).

Russell, L. B. and Russell, W. L.: "Hazards to the embryo and fetus from ionizing radiation" Proc. Int. Congress Peaceful Uses of Atomic Energy, Geneva (1955), II:175 (U.N. Pub. 1956).

Russell, L. B. and Russell, W. L.: "Analysis of changing radiation response of developing mouse embryo." Jour. Exp. Zool. 131:329-395 (1956).

---

* See H. J. Muller's papers:

"The production of mutations." Jour. Heredity 38:259, 1947.

"Radiation damage to genetic material." Am. Scientist 38:1, 1948.

"Damage to posterity caused by irradiation of the gonads." Am. J. Obs. & Gyn. 67:467, 1954.

"Damage from point mutations in relation to radiation dose and biological conditions." From WHO, Geneva, 1957.

"General survey of mutational effects of radiation." Chap. 6 in Radiation Biology and Medicine, eds. W. D. Claus, Addison-Wesley Pub., Inc. 1958—

WHO says: "The frequency (of gene mutations) is directly proportional to the total dose received" . . . and "There is no dose too small to have some effectiveness" . . . and "there is no recovery from the mutational effect" . . . and "Most individual lethal mutations represent the effects of individual 'hits,' that is, individual ionizations or other activations . . . that arise in the tract of an ionizing particle."

Radio-Biological Research at the National Naval Medical Center

By

Rear Admiral C. B. Galloway, MC, U. S. Navy*

I SHALL discuss briefly the general organization of the Research Program of the Medical Department of the Navy and specifically the Program in Radiobiological Research at the National Naval Medical center as it relates to the rapidly changing techniques of Military Medicine.

Medical research within the Department of the Navy is organized to support the operating forces and to anticipate the biomedical demands of our changing weapons systems. We believe that the best research originates in the field at the operating level and is generated by those in direct and continuing contact with the operational or clinical problems. In support of this philosophy, we have placed our Major Laboratories in close proximity to the Operating Forces. Submarine Medicine Research is primarily accomplished at the submarine base, New London, Connecticut; Aviation Research at the School of Aviation Medicine, Pensacola, Florida, which is an integral part of the Naval Air Training Command; Equipment Research at the Air Crew Equipment Laboratory, Philadelphia, Pennsylvania, and Acceleration Research at the Aviation Medical Acceleration Laboratory, Johnsville, Pennsylvania. Amphibious and Field Research is accomplished at the Marine Corps Base, Camp Lejeune, North Carolina. Studies on Tropical and Exotic Diseases uncommon in the United States are accomplished in the Middle East, the Far East, and in Panana. Research on the Respiratory Infections has been a continuing

* Bureau of Medicine and Surgery, Department of the Navy, Washington, D.C.

U. S. Navy Photo

Fig. 1. U. S. Naval Hospital, National Naval Medical Center, Bethesda, Maryland. Lighter area in foreground is projected construction.

U. S. Navy Photo

FIG. 2. The Naval Medical Research Institute, National Naval Medical Center, Bethesda, Maryland.

effort at the Great Lakes Naval Training Station since World War II. The problems of Mental Health have been recognized for many years as an important area for investigation. We have established a Neuro-Psychiatric Research Laboratory at San Diego. This group is studying a cross-section of American Youth from West of the Mississippi. It is their mission to determine the impact of the military way of life upon the individual, to follow the psychiatric casualties at the Naval Hospital, San Diego, the disciplinary casualties at the Naval Retraining Command, and to study intensively the borderline emotional disorders. We are making every effort to recognize early, to identify, to evaluate, and to assess the behavioral and personality defects incompatible with effective Military Service.

The day of the individual scientist working alone is largely a thing of the past. Military research today demands the focusing of many disciplines upon new problem areas. The advice and guidance of the Physicist, the Statistician, the Mathematician and the Engineer have become essential with the increasing complexity of our weapon systems. Clinical research, both basic and bedside, likewise demands the coordinated efforts of many disciplines, the Physiologist, the Biochemist, the Bacteriologist, the Pathologist, frequently the Medical Zoologist, the Entomologist, and others.

In brief, our major research effort is in the field. Our laboratories are integrated with day-to-day military operations. Our research is accomplished by civilian scientists and Naval officers with special research competence. Basic support for these satellite laboratories is provided by the Naval Medical Research Institute, Bethesda, Maryland, which has on its staff outstanding authorities in the major disciplines.

Current research in radiobiology at the National Naval Medical Center is an excellent example of a coordinated inter-command program. The tissue bank of the Naval Medical School was organized for the procurement, storage, and surgical application of homografts, which currently include bone, skin, fascia, dura, cornea, cartilage, and arteries. This Clinical and Developmental Transplantation program is today the largest, and probably the best, in the United States. Promising areas in this field relate to the use of the homograft in the critically burned, the possible development of a reconstituted biological film as a burn dressing, the grafting of tissue-cultured embryonic ovary for its endocrine value, leucocyte motility as a possible index of the re-populating capability of bone marrow and a coordinated project utilizing the latest advances in Nuclear Medicine for developing and evaluating the place of stored human marrow in the treatment of patients subjected to sub-lethal or lethal doses of radiation.

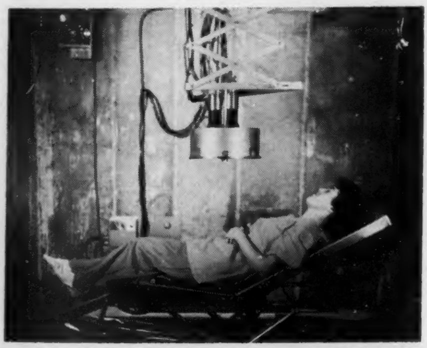
Recognizing the need for trained person-

U. S. Navy Photo

FIG. 3. The Radiation Evaluation Exposure Laboratory, National Naval Medical Center, Bethesda, Maryland.

nel in the clinical and research application of radionuclides, the Naval Medical School has established a four months' training course for medical officers and a three months' training course for laboratory technicians. A course in nuclear nursing provides Nurse Corps Officers trained in the therapeutic and diagnostic use of radioisotopes and the clinical care of the radiation patient.

The United States Navy is the major user of Nuclear Propulsion; with an increasing number of ship-borne reactors, the need for medical department personnel trained and experienced in the day-to-day medical problems of reactor operations became obvious. In 1957, a small five-watt reactor was installed at the National Naval Medical Center as a source of short half-life isotopes. This reactor provides training in the day-to-day problems of reactor operations, the problems of the Radiophysicist and the problems of the Radiation Hygienist. In 1958, an auto-radiography laboratory was established for a better understanding of histological changes as related to a more precise study of the individual cell, and the histochemistry of diseased tissues. You will be interested to know that some three years ago the American Board of Pathology, recognizing the importance of isotope techniques in the practice of pathology, authorized the substitution of four months training in clinical radioisotopes for an equivalent period of the required residency training in pathology.



U. S. Navy Photo

Fig. 4. Whole Body Counting of Internally Deposited Radioactive Materials, using 3 Sodium Iodid (Thallium Activated)—NAI(Tl)—Crystals as Radiation Detectors, in a Lead-lined Room Specially Fitted Out for Low Background Counting.

Artist's Drawing Released by Dept. of Defense

Fig. 5. Armed Forces Radiobiology Research Institute, National Naval Medical Center, Bethesda, Maryland.

The use of direct bone marrow transfusions for the treatment of radiation casualties has generated tremendous interest in the collection, storage, and use of this tissue. This is a joint study of the Naval Medical Research Institute, the Naval Hospital, and the Naval Medical School. It is a joint staff effort in every sense of the word, and admirably serves both the clinical and the research requirements of these commands.

On October 14, 1960, the Honorable James H. Wakelin, Assistant Secretary of the Navy for Research and Development, dedicated a new radiation exposure evaluation laboratory at the National Naval Medical Center. This laboratory was designed to measure the body burden of ingested or inhaled radioactive materials, to establish a background level for normal individuals, to monitor those assigned to reactor operations and as a center for the more precise clinical study of the nuclides.

In brief, our scientists are creating a coordinated radiobiology research competence, a competence that includes conventional radiation sources, experimental sources, short half-life isotopes, tissue culture facilities, expanding histological techniques, training facilities, and above all provides the individual patient with the best and most advanced therapeutic and diagnostic techniques of modern medicine.

Radiological Hygiene Program of the U. S. Army

By

Colonel Adam J. Rapalski, MC, *U. S. Army**

and

Lt. Colonel Maxwell Dauer, MSC, *U. S. Army (Ret.)*†

THE widespread and increasing utilization of a great number and variety of radioactive materials and other sources of ionizing radiations used in medicine, for scientific and technological purposes, in industrial processes and equipment, and to serve the military requirements within the U. S. Army has necessitated an expansion of the Army program in radiological hygiene.

The program, briefly reviewed here, is under the technical supervision and guidance of The Surgeon General of the Department of the Army. It is designed to assure that adequate safeguards are provided to control and minimize potential radiation health hazards to those occupationally exposed, as well as to others in the immediate environment who could inadvertently be exposed. The occupational group in 1960 was approximately 15,000 persons. This number is increasing monthly as newer technology introduces radioactive materials and ionizing radiation sources into the day-to-day routines as well as into many research and unique activities of the Army.

At all Army installations, camps, posts, and stations, the Post Surgeon, together with the Preventive Medicine Officer, or other personnel qualified in health physics, integrate the requirements for radiological hygiene into the existing Occupational Health Program.[1] Basically therefore the program is a component of the broad Army preventive Medicine Program.

Within the Army, there are many sources of radiation to which personnel may be exposed on an occupational basis. Table 1 is a tabulation of the radiation devices and sources in the U. S. Army. The number, type and complexity of radiation sources are constantly changing. Each year, the number in use increases. The trend is towards increased utilization of various radioisotopes for many purposes, of high voltage generating equipment such as accelerators, of nuclear reactors for research and as a source of power. By 31 December 1960 a total of 98 licenses had been issued by the U. S. Atomic Energy Commission authorizing the procurement and use of radioisotopes within the Continental U. S. Army. The quantity of byproduct radioactive material in use was approximately 25,000 curies.

The Surgeon General has the responsibility within the Army[2,3] to review and approve all applications for U. S. Atomic Energy Commission byproduct material (radioisotope) licenses and license amendments. Before recommending approval of the U. S. Atomic Energy Commission (AEC) of an application of a particular installation, The Surgeon General has it reviewed to assure that adequate facilities, appropriate instruments and equipment, and adequate procedures are available and that the individuals who will handle the requested types and quantities of byproduct material are so qualified that there will be no undue hazard to themselves, to others engaged in the work or to persons in adjacent areas. In this manner definite controls are exercised to minimize radiation health hazards. Periodic visits to this installation by representatives of The Surgeon General and/or AEC personnel are

This paper was presented at the Annual Meeting of the American Conference of Governmental Hygienists, Detroit, Michigan, April 10, 1961.

* Commanding Officer, U. S. Army Environmental Hygiene Agency, U. S. Army Medical Service, Army Chemical Center, Maryland.

† Recently, Chief, Radiological Hygiene Division of the U. S. Army Environmental Hygiene Agency. Now Associate Professor of Radiation Physics, Department of Radiology, University of Miami School of Medicine, Coral Gables, Florida.

TABLE 1

IONIZING RADIATION SOURCES IN THE U.S. ARMY AS OF 31 DECEMBER 1960
Distribution by Army Areas

	1	2	3	4	5	6	MDW	Other*	Total
Medical X-Ray[a]	104	112	99	148	148	129	55	4	799
Non-Medical X-Ray[a]	56	45	15	7	21	5	11	0	160
Accelerator	5	1	2	0	2	2	1	0	13
Nuclear Reactor[b]	1	0	0	0	0	0	1	2	4
Other Radiation Equipment[c]	0	4	2	0	3	1	12	0	22
Isotopes (AEC)[d]	137	282	100	75	57	37	96	0	784
Radium[d]	3	4	0	3	2	3	3	0	18
Kilocurie Sources (Co 60)[e]	2	2	0	0	2	0	1	0	6
AEC Licenses	13	21	9	10	16	20	9	0	98

* Does not include sources deployed with overseas commands, except as indicated. AEC licenses are not required for byproducts with such forces.

[a] Includes all x-ray units up to 2 million volts, but does not include such equipment deployed with overseas commands as in Europe, Korea, Japan, etc.

[b] Nuclear reactor in operation at Ft Belvoir, Va.; Ft Greely, Alaska; Greenland and Watertown Arsenal, Mass.; Under construction—Walter Reed Army Medical Center (WRAMC) (1); Planned—Aberdeen Proving Ground, Md. (1), Picatinny Arsenal, N.J. (1), Forest Glenn, Md., (1), White Sands, New Mexico, (1).

[c] Includes: Radioactive Static Eliminators, Beta-Ray Gauges, and Electron Microscopes.

[d] For the isotopes listed, each installation may have many individual sealed or unsealed sources in the solid or liquid state.

[e] Dugway Proving Ground, Utah—3100 curies, Rock Island Arsenal, Ill.—6500 curies, Frankford Arsenal —3200 curies, Quartermaster Corps, Research & Development Program, Natick, Mass.—1 million curies (to be installed); Walter Reed Army Medical Center—2200 curies; Aberdeen Proving Ground—17,000 curies (planned).

made to insure that all the provisions of the licenses are being carried out. It should be emphasized that the decision whether or not to use radioisotopes in a project or research activity in a command responsibility and that approval by The Surgeon General of an application for a byproduct license does not constitute approval of any specific project for the use of radioactive materials. The approval serves as advice to the AEC that in the opinion of The Surgeon General the proposed use will not create uncontrolled radiation health hazards and that precautionary measures meet the requirements of the AEC as well as the best current concepts and recommendations of other competent agencies and scientific bodies.

Within the Army, the Chemical Corps has the technical responsibility[4] for the off-site disposal of radioactive wastes. At present, no permanent radioactive waste burial sites are maintained by the Army. Byproduct wastes are usually disposed of by an installation by shipping the material to designated radiological waste disposal facilities maintained by the Chemical Corps. The Chemical Corps prepares these materials for shipment to selected burial sites operated by the Atomic Energy Commission. Local disposal of radioactive wastes in excess of levels recommended by the National Committee on Radiation Protection[5] is not permitted unless specifically authorized by The Surgeon General. It is the policy of The Surgeon General to keep the local health authorities fully informed on any such matters. In this way, local health officials are provided with accurate and timely data and are prepared to answer any questions which may be raised by the public in these areas. This is an important factor in maintaining good public relations and to dispel any fears which people near an installation may have. Accurate information in the hands of these officials is of considerable assistance

in preventing public objection to the use of radioactive materials at a particular installation.

For many years, radium and its daughter products have been incorporated in various items of military equipment. During World War II, extensive use was made of radium in luminous markers, compasses, metascopes, electron tubes, and other items. Manufacturing such items, if no adequate controls are in being, certainly involve significant risks—no better example exists than the epidemiology of occupational disease in the radium dial workers. Used alone, these items usually do not present a significant hazard. However, in situations where larger numbers are used or handled in a localized area or within a storage area, there is the danger of external overexposure, the danger of internal contamination from leaking sources and the danger of inhaling excessive quantities of gaseous radon, one of the daughter products of radium. The inhalation problem of radon becomes serious when the items are stored in an improperly ventilated room. Wherever possible, attempts have been made and are being made to replace radium with less hazardous materials throughout the Army. Obsolete or defective items containing radium have been disposed of by the Army by dumping it in the ocean at specifically designated locations in special containers.

Within recent years, a number of kilocurie radioisotope sources have been procured for use within the Army. These sources are usually cobalt-60 and are used in industrial radiography and medical radiation therapy or for research and development purposes. One of the largest radiation sources will be the one million curie cobalt-60 source to be used by the Quartermaster Corps in connection with its research and development program for preservation of food by radiation. The medical aspects of which are being very closely coordinated with the Army Medical Research and Development Command.

The magnitude and scope of the radiological health program in the Army can be further visualized by the realization of the fact that the sources of ionizing radiation are located at more than 255 installations and activities within the continental United States. Some concept of the protection problem can be gained by a knowledge of the number of film badges processed by the Signal Corps. Each month approximately 30,000 film badges are processed. Dependent upon local requirements, film badges may be processed weekly, monthly or at other intervals.

The initiation of policy, the preparation of directives, and the provision of technical and professional advice on all matters relating to health, including the hazards of radiation, as they pertain to the military and civilian personnel of the Army is a statutory responsibility of The Surgeon General. The U.S. Army Environmental Hygiene Agency of the Army Medical Service[6] is maintained and staffed by The Surgeon General as an operational facility whose principal mission is to support the Army's broad preventive medicine program by providing consultative services in the many disciplines needed in a comprehensive program. It is therefore an organization which can provide specialized levels of scientific and professional competence to supplement and support those that may be available at local (posts) and regional (Army) levels. The Staff includes personnel with high levels of competence in radiological hygiene problems. The Agency makes radiological hygiene field surveys at installations possessing sources of ionizing radiation. These surveys insure that the Post Surgeon at the installation and others responsible for the local program are given technical guidance on various aspects of acceptable radiological hygiene practices and procedures. These surveys, prepared as a report, provide the installation with a complete inventory of all the sources of ionizing radiation in use. The report is an evaluation of the existing radiation protection program at the installation and contains recommendations designed to insure conformity to Army regulations,[2,7,8] U. S. Atomic Energy Commission requirements[9] and other applicable radiation standards or guides formulated by the National Committee on Radiation Protection and the Federal Radiation Council.[10] These survey

reports also serve as the basis for making determinations regarding the adequacy of the facilities and the qualifications of designated indivduals to be licensed by the AEC by byproduct radioisotopes. The services of the U. S. Army Environmental Hygiene Agency are also available to provide assistance on radiation shielding and design of facilities or equipment. The Agency is developing the capability to perform radiological analyses of body fluids and tissues of personnel[11] who may accidentally have been internally contaminated by radionuclides, or where there is a question as to whether internal contamination has occurred.

At the individual Army installations, it is the function of the Post Surgeon, or physician, if an Army officer is not available, to supervise and direct the local radiological hygiene program as a part of his existing responsibility for the control and regulation of other occupational and environmental health hazards. In this capacity, the Post Surgeon maintains a current inventory of sources of ionizing radiation. He advises commands on the adequacy of the precautions taken in all operations and facilities so that personnel are not unnecessarily exposed to radiation.[12] An important part of this program is the preplacement medical examination and the special followup examinations. It is essential that personnel who have a previous history of excessive exposure to radiation, who show clinical evidence of radiation exposure, or who have disease that may be adversely affected by radiation should not be given occupational duties involving this type of hazard. In cases where there has been an overexposure to radiation, it is the Post Surgeon who takes the necessary action to provide the necessary medical treatment and care and to recommend the precautionary or corrective measures which may be indicated. The Post Surgeon is also expected to provide information on radiation health protection and to insure that adequate health procedures are followed with regard to disposal of radioactive wastes.

At certain Army installations where a large number and types of ionizing radiation sources are in use, health physicists and qualified industrial hygienists or sanitary engineers are assigned the responsibility for the accomplishing of much of the detailed requirements of the program. The Post Surgeon with the assistance of the Preventive Medicine Officer, if one is assigned, is still responsible for the operation of the specific program so that it functions smoothly as a part of the existing overall installation occupational program.

The radiation standards or guides which are used for occupational exposure in the U. S. Army are listed in Table 2 and Table 3. These radiation exposure levels are based upon the recommendations of the National Committee on Radiation Protection and the Federal Radiation Council.

A great number of x-ray machines are in use within the Army for diagnostic and therapeutic purposes. These exposures are kept to a minimum consistent with the medical requirements of the patient as determined by the physician. Continuing efforts are made to insure that radiographic techniques and procedures[13] are used which expose the patient to the minimal amount of radiation needed to obtain the required diagnostic information. During 1960, approximately 10,000,000 x-ray films were used in the Army for various medical and dental purposes. Because of the large volume of exposures to this segment of the population, it can be seen that measures to minimize exposure without restricting the medical benefits or hampering the physician in obtaining the necessary diagnostic films are a worthwhile effort. Procedures and techniques to minimize patient exposure require a program of continuing education and understanding, and over the years will justify all the work which is put in to support such a program.

The nuclear reactor program of the Department of the Army, whether for research or for power sources, has in itself placed additional heavy responsibility on the Army Medical Service. The control of health hazards associated with this program involves not only the application of the classical engineering and monitoring approaches used in

TABLE 2

RADIATION PROTECTION GUIDE*

Type of Exposure	Condition	Dose (rem)
Radiation worker:		
(a) Whole body, head and trunk, active blood forming organs, gonads, or lens of eye...	Accumulated dose...	5 times the number of years beyond age 18.
(b) Skin of whole body and thyroid........	13 Weeks...........	3.0
	Year...............	30.0
(c) Hands and forearms, feet and ankles....	13 weeks...........	10.0
	Year...............	75.0
(d) Bone..............................	13 weeks...........	25.0
	Body burden........	0.1 microgram of radium-226 or its biological equivalent.
(e) Other organs........................	Year...............	15.0
	13 weeks...........	5.0
Population:		
(a) Individual..........................	Year...............	0.5 (whole body)
(b) Average............................	30 year............	5.0 (gonads)

* As printed in the Federal Register, 18 May 1960, and as approved by the President, 13 May 1960

TABLE 3

EXPOSURE OF INDIVIDUALS TO RADIATION IN RESTRICTED AREAS*

Rems per calendar quarter

1. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads....	1¼
2. Hands and forearms; feet and ankles......	18¾
3. Skin of whole body....................	7½

* As printed in the Federal Register 7 September 1960, with effect 1 January 1961.

TABLE 4

DETERMINATION OF ACCUMULATED DOSE*

Part of Body	Column 1 Assumed exposure in rems for calendar quarters prior to Jan. 1, 1961	Column 2 Assumed exposure in rems for calendar quarters beginning on Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye.	3¾	1¼

* As printed in the Federal Register 7 September 1960, with effect 1 January 1961.

controlling environmental and occupational health hazards, but also, because of the nature and magnitude of the potential hazards, it requires the application of new approaches and techniques as yet perhaps not fully developed, if maximum control is to be achieved and all eventualities are to be adequately handled. The program is a dynamic one that benefits from accumulating experience and evolving concepts. This phase of the radiological hygiene program of the Army will undoubtedly be of value to other Government and civilian programs of this nature.

SUMMARY

A brief review is made of the radiological hygiene program of the U. S. Army, and how it fits into the broader comprehensive preventive medicine and specific occupational health programs of the Army Medical Service.

REFERENCES

[1] AR (Army Regulation) No. 40-557, Medical Service, "Occupational Health Services of the Army."

[2] AR No. 40-580, Medical Service, "Control of Hazards to Health from Radioactive Materials."

[3] Department of the Army Circular No. 40-17,

Medical Service, "Applications for Atomic Energy Commission Byproduct Material Licenses and License Amendments," 10 January 1961.

[4] AR No. 755-380, Disposal of Supplies and Equipment, "Disposal of Radioactive Material" and Changes No. 1.

[5] National Bureau of Standards Handbook No. 69 (Recommendations of NCRP), "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure."

[6] AR No. 40-25, Medical Service, "U. S. Army Environmental Hygiene Agency."

[7] AR No. 40-414, Medical Service, "Noncombat Personnel Dosimetry."

[8] AR No. 40-431, Medical Service, "Record of Exposure to Ionizing Radiation."

[9] Federal Register, Title 10, Chapter 1, Part 30, AEC Regulations for Licensing Byproduct Material, as amended, U. S. Government Printing Office.

[10] Federal Register, Title 10, Chapter 1, Part 20, Standards for Protection Against Radiation, as amended, U. S. Government Printing Office.

[11] AR No. 40-582, Medical Service, "Evaluating and Reporting Internal Exposure to Radioactive Materials."

[12] TB MED No. 254, "Permissible Dose from External Sources of Radiation."

[13] TB MED (Department of the Army Technical Bulletin, Medical) No. 62, "Medical X-Ray Protection."

★

U. S. Army Photo

AERIAL VIEW OF THE U. S. ARMY HOSPITAL, CAMP ZAMA, JAPAN
Insert: COL. LOUIS S. LELAND, Commanding Officer
(Ordered to Walter Reed General Hospital, Washington, to be Chief of Dermatology.)

Clinical Aspects of Radiation

By
Colonel Gerrit L. Hekhuis, USAF, MC*

LONG before the atomic explosion the scientific literature of the world is sprinkled with case reports and incidents of changes in normal tissue or function as the result of exposure to radiation. Since the time of the atomic bomb, the literature has become almost saturated with reported effects, and these changes are reported not only in the scientific journals, but just as frequently and with considerably more drama in the weekly and monthly periodicals that come into our homes.

In our consideration of what and how many of these changes are of significance in formulating the clinical picture of radiation, it is not sufficient merely to review them in parade. Each investigator has done a most thorough job with the investigation at hand, and each one has been convinced that his final report was a thorough discussion of an experiment or finding. This singleness or narrowness of understanding has done much to delay and confuse the true realization of the radiation syndrome. Some excellent reviews have been written and presented, and it is with admiration for the clearness of thought and analysis that I borrow heavily and freely upon these papers for this brief discussion.

There exists today a number of varied approaches to finding out what happens when radiation affects a living tissue. In review, let me present a few of these. There are mathematical approaches, graphical approaches, and purely clinical approaches—but each of these is inadequate and describes only one view of a complex multifaceted problem.

How, then, should we approach the problem of describing and observing the clinical radiation changes which are obtained in humans? We must go to sources which will give us the best information, that which we can accept with reliance, and which is scientifically documented. Among these sources we have animal experimentation, local radiation therapy, total-body radiation therapy, Japanese patient records, nuclear accidents, and exposure accidents concerned with reactor experiments. All of these must be correlated to provide a valid total picture.

And what do we observe? We can find changes in almost every tissue or endpoint we wish to observe. Some are vital, others are insignificant. Perhaps the easiest to study are the changes which occur similarly in many species, and thus can be considered a general result of radiation exposure. One of these factors is the white blood count. From these data we find that the response in depression of the white blood cell is roughly proportional to the dose of radiation administered.

From another set of data we see that the response in man measured by the white blood count depression is roughly the same whether the radiation comes from an atomic bomb with its mixed radiation types, fallout from a nuclear explosion with mainly beta and gamma, nuclear accidents, which have gamma and neutron components, and the application of only x-rays from an x-ray generating machine.

Another type of reaction is found in another set of data. In this we evaluate the sign of vomiting, matched against the time of onset. Each of the incidents represents a different case. If one were confined to only one set of reports, the data would be insufficient to allow deductions. But, by coupling and correlating all sources, we may find a pattern which is a valid summarization. Further, if we compare the frequency with which any given response is found to the dose of radiation given, we find this follow-

---

The contents of this paper reflect the personal views of the author and are not to be construed as a policy of the Department of Defense or the Air Force.

* Chief, Radiobiology Branch, School of Aerospace Medicine, U. S. Air Force, Aerospace Medical Center, Brooks Air Force Base, Texas.

ing relationship in general terms.

At this point it is well to borrow from one of the battle cries of Dr. Marshall Brucer, of the Oak Ridge Institute of Nuclear Studies. He emphasizes the importance of clinical observation in the animal of concern, whether he be the man, or the laboratory animal being studied. He cautions against unwarranted application of data obtained on one kind of animal to an expected response in another species of animal, and sums up with his often repeated "A Man is NOT a Mouse!"

If a man is not a mouse, then we have to look at a man to find out how he reacts to radiation exposure. The next discussion will present a summary of these findings. First, we categorize the various classes of response according to dose, and we relate the dose to the days of survival, indicating at the same time the three main modes or characteristic types of deaths observed; hematopoietic, gastrointestinal, and cerebral.

Let us now look a little more closely at the three main types of radiation response. The first is the condition associated with the lowest of the three dose levels, and the organ system showing the most obvious changes is the hematopoietic, or blood-forming and blood clotting component of life. I would call your attention to the time scale in weeks and the duration of each of these phases of observation.

The second category is with the mid-range dose of radiation, and in this range the characteristic organ system showing the most spectacular and critical changes is the gastrointestinal tract. Again, the time scale, in days, is most important, and thus the evaluation of severity and time of onset and duration of the findings become compressed.

The third range is the highest dose group, and time is further compressed so that we are now dealing with hours post radiation rather than days or weeks. Again, the incidents of the various responses is such that many changes are present simultaneously, and there is considerable overlap of findings. This of course greatly complicates the evaluation of each of the findings.

Now let us consider a brief summary of these, and we find an indication of some of the interpretation. Not only are we describing, but now we are predicting which cases we can hope to help, and which are apparently too severe for our present therapy to benefit, and also at the lower end we find those who need no heroic medical therapy, but can be returned to effective work and performance after reassurance, observation and evaluation.

For those who do need therapy, there are a few things we find are effective, and these can best be summarized under the categories of chemicals which absorb or block the energy given off by the radiation, and thus prevent as severe reactions in the living tissues. Second, the types of therapy which replace components or cells which have been damaged or lost, and this replacement may be a true transplantation, or merely a time bridge to tide the individual over until his own cells can again become effective in maintaining what we call normal life. Thirdly, a group of medications which we call supportive. These might be antibiotics to prevent an additional stress or insult in the form of infection, or additionally a sedative to allow the rest that is so necessary.

But the presence or knowledge of this type or approach to therapy is not enough. What of the size of the problem? What is the amount of care expected? The number of patients who will require hospitalization? And, the expected duration of hospitalization for these patients? When coupled with the availability of hospital beds in our cities, this becomes an almost overwhelming problem. We must then utilize every form of treatment most efficiently.

Perhaps the most important factor in all of this clinical picture is the observation, evaluation, and treatment of the patient. It is foolish to treat the dosimeters or the lab reports. The doctor in such overwhelming tasks must rely on his best available and efficacious care.

To accomplish this treatment we do have one factor in therapy that has not been mentioned often enough, nor stressed enough. This lies in our utilization of edu-

cated and trained patient care personnel. The factor of patient care can only be accomplished effectively when a good rapport exists, and when the treatment prescribed can be known to be given as directed. The success or failure of any treatment rationale, then depends on one thing, and this is effective administration. To this end must be our efforts, and from this end we will obtain our survival.

Abstract

HUMAN COCCIDIOIDOMYCOSIS

C. E. Smith, D. Pappagianis, H. B. Levine, and M. Saito

This paper was presented at a Conference on Airborne Infections 7-10 December, under sponsorship of the National Academy of Sciences, National Research Council and appears as part of its Proceedings in *Bacteriological Reviews*, of September, 1961, Vol. 25, No. 3. The major part of the epidemiological conclusions has come from the activities of the Commission on Acute Respiratory Diseases of the Armed Forces Epidemiological Board.

Human Coccidioidomycosis is an unfortunate by-product of the "pathogenic saprophyte," *Coccidioides immitis,* when its spores are inhaled and produce respiratory infection in man. The human infection is accidental and is unrelated to the perpetuation of the fungus in nature. The human infection is extremely variable. Most residents of the arid endemic areas of the Southwest are infected and while most primary infections are symptomless, the number which produce acute illnesses constitute a significant problem. Increased dosage appears to be associated with increased pathogenicity. The resulting pulmonary residuals constitute problems of diagnosis in confusion with tuberculosis and lung cancer, while pulmonary cavities are difficult to manage. The most serious concern is the extrapulmonary spread, disseminated or progressive primary coccidioidomycosis. Deaths in the United States from this complication range from 50-75 per year.

In considering methods of control, the "saprophytic" character of *Coccidioides* with its widespread distribution in nature makes eradication impossible. Dust control where, as in military installations, personnel are present for a limited time, has proved alleviative, but long time residents eventually will be infected. Indeed, in considering "host" factors, children appear to handle the infection better than adults, so there may be a disadvantage in delaying the infection to adult years. The white female (except possibly during pregnancy) copes with her infection best; the adult Negro or Filipino male, the worst. The relatively solid immunity conferred by the initial infection points to artificial immunization as a solution if an appropriate measure can be devised. There are promising leads in the use of avirulent living strains and, especially, of killed spherule vaccines. In experimental animals these vaccines have not *prevented* infections but the infections have not progressed to lethality unless the challenge has been enormous.

Another very valuable control measure would be a safe, effective antibiotic. Amphotericin B, which is proving very valuable in treating non-meningitic dissemination, thus far is too toxic to be widely used in treatment of primary infections to abort dissemination.

Thus, epidemiological consideration of human coccidioidomycosis points to the necessity of concentration on the potential human host rather than on the eradication of the organism in nature or even environmental control. By making man resistant to the "pathogenic" characteristic of the "pathogenic saprophyte" or, if infected, by eradicating the infection before it becomes progressive or results in pulmonary cavities, we shall have solved this problem.

Visual Aspects of Radiation Exposure

By

Major James F. Culver, USAF, MC*

(With two illustrations)

WITH REGARD to the eye, and other parts of the human body as well, we can liken radiation to a two-edged sword. Excessive amounts of radiation can cause the loss of man's vision but radiation, properly directed, can be responsible for its preservation. Without certain portions of the electro-magnetic spectrum the eye would be useless, for we obtain a visual response, or see, only when that portion of the electro-magnetic spectrum between 400 and 800 millimicrons, or 4000 to 8000 Angstrom units, stimulates the retina. It is such radiations that inform us when an attractive lady passes by. Radiations in the 700 millimicron range tell us that she has bewitching red hair, those in the 470 millimicron range that she has beautiful blue eyes, and a combination of all in the visible range that the proportions are correct, speaking in Angstrom units, of course.

Radiations from the visible spectrum that are responsible for providing pleasure can also contribute to blindness or a marked loss of vision if sufficiently concentrated to burn the retina. We have observed such retinal damage in cases of "eclipse blindness" due to a constant exposure to the sun's rays for more than several seconds. It can also occur from exposure to the flash of a nuclear detonation for less than 0.1 second, which happens to be the time of the average human blink reflex. Our blink reflex is not fast enough to prevent ocular damage from the thermal energy of a nuclear detonation, which may have a peak emission before 0.01 second, and may reach a brightness of up to or beyond 100 times that of the sun.[1,2]

The fact that chorio-retinal damage could occur at much greater distances from such an event than skin burns is not generally realized. Experiments utilizing rabbits in 1953 by researchers from the USAF School of Aviation Medicine demonstrated retinal burns at distances out to 42.5 miles, and it was also predicted that such burns could occur at much greater distances.[2] There appeared in the June 6, 1959 issue of the *Washington Post* a front page article headlined, "High A-Blast Peril Great, Report Says." It further stated, "The test shot 'Teak' made at an altitude in excess of 200,000 feet at 11:50 P.M. on July 31, 1958 produced partial blindness in rabbits 40 to 300 miles from the blast." Figure 1 shows such a lesion as might be found in a rabbit stationed at or beyond the 300-mile range. Figure 2 shows a similar lesion found at a range of closer than 60 miles.

The size and severity of the lesion depends upon the radiant emittance of the source, duration (limited by a blink reflex), size of pupillary aperture, and the specific absorption and attenuation of the atmosphere and ocular media.[2,3] If we eliminate the various attenuations, the amount of energy incident per unit area on the retina is essentially independent of the distance from the source, although at greater distances the size of the image becomes smaller. The danger of retinal damage is considerably greater at high altitude because of the rarefied atmosphere, hence less attenuation of the radiations, and at night because of the dilated pupil with an opening 60 times that of the pupillary aperture in bright daylight.

Since the thermal energy produced by the flash of a nuclear explosion is delivered so

---

The contents of this paper reflect the personal views of the author and are not to be construed as a statement of the official policy of the Department of Defense or of the Air Force.

* Chief, Ophthalmology Branch, School of Aerospace Medicine, U. S. Air Force, Aerospace Medical Center, Brooks Air Force Base, Texas.

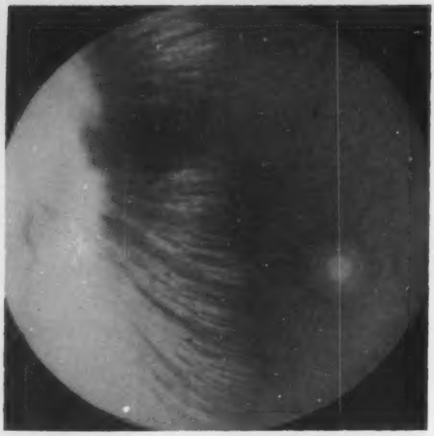


FIG. 1. Retinal burn. Rabbit 300 miles from nuclear explosion.

rapidly that the human blink reflex time is not rapid enough to protect the eye, numerous methods of protection are under investigation. These include colored filters of high density which offer protection but are not practicable for constant wear and interfere with ordinary activities.[4] Electro-mechanical goggles are available, which will close in microseconds but still not offer complete protection. These are somewhat bulky due to the necessity of power packs, and also cause some restriction of the visual field.[5] In recent years photochromic dyes have been under investigation, which have the property of changing from a clear to a colored state by the action of visible light, mainly in the ultra-violet region of the spectrum.[6] The U. S. Air Force has a major research project in this field and recent developments appear quite encouraging. It is hoped that these self-attenuating, variable density filters will prove feasible for use in goggles, canopies, windows and other optical devices within the very near future. Other types of photochromic materials, such as the Triplet state compounds, may also offer some very exciting possibilities. These filters, which are reversible, can change within a few millionths of a second. Such materials can be laminated or applied as surface coatings, and even perhaps be actually imbedded in material such as plastic. With the perfection of such a device we could offer adequate protection. Flash blindness, though only a temporary phenomenon caused by radiations from this same portion of the spectrum, is a serious problem to the military commander. Due to a temporary scotoma, the pilot, if partially or completely dark-adapted, is unable to discriminate differences in contrast following exposure to bright light. The severity and recovery time are directly related to exposure time and the intensity of the radiant energy flash. This may not be a serious problem during daytime activities, but when dark-adapted on a night mission several minutes may be required before the pilot would be able to see his instruments and at least one-half hour before complete adaptation occurs. Such an event could cause a mission failure and disaster.[7]

Let us now examine the effects of wave lengths that are longer and shorter than visible light. On the long side, we find the infra-red radiations which we know to produce the infra-red or "glass blower's" cataract. Above this we find radio and microwaves, such as are associated with high powered radar devices, and which have been re-

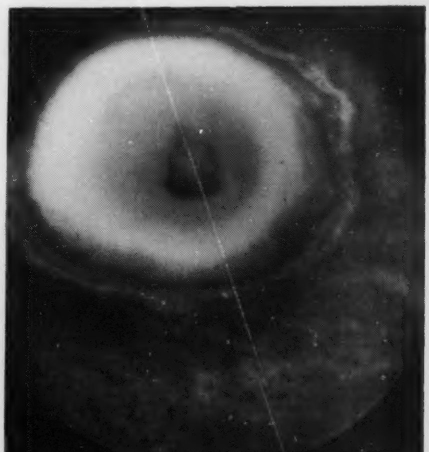


FIG. 2. Retinal burn. Rabbit less than 60 miles from nuclear explosion.

ported to induce cataracts in experimental animals. Whether microwaves will cause a cataract in man is currently debated.[8] On the shorter side, we find the ultra-violet radiations which occur mainly from such sources as welder's arcs and quartz mercury vapor lamps. These are only mildly penetrating and induce a kerato-conjunctivitis and an erythema of the lid. After a latent period of five to twelve hours the patient complains of pain, photophobia, and lacrimation, and punctate epithelial erosions of the cornea are detected under the slit lamp. The effects are temporary but may incapacitate the individual for from twelve to twenty-four hours.

The remaining shorter wave length radiations' chief mode of energy dissipation is by ionization. They can induce a variety of lesions in the eye, depending upon the penetration of the rays which in turn depend upon the energy of the radiation. Soft X-rays are relatively non-penetrating and usually produce only a superficial kerato-conjunctivitis and dermatitis. The threshold dose is around 1000 r. Hard X-rays, which are more penetrating, can produce superficial keratitis, cataracts and retinal damage.[8,9,10]

The visual effects of ionizing radiation on the lens may seem mysterious because of the delayed macroscopic appearance. However, basic effects are instantaneous and have been demonstrated microscopically by Von Sallman within ten minutes after exposure.[11] The lens is more susceptible to repeated radiation due to its slower rate of repair as compared to the cornea and skin. The latent period for keratitis and dermatitis is a matter of weeks, while the latent period for cataract is often a matter of years.

The USAF School of Aerospace Medicine has attempted to clarify further the cataractogenic threshold dose for man. Experiments were begun in 1952, using several hundred small Rhesus primates. Results from these studies are as follows. A 30:1 gamma-neutron mixture delivered once weekly for three months resulted in no clinically visible lens changes one and one-half years after total doses up to 500 REP. Other experiments, using a 9:1 mixture of gamma-neutron radiation, showed extremely minimal but insignificant changes in the lens after three and one-half years, with exposures up to 600 REP. Other animals were given acute single exposures to the head and the cataractogenic threshold for the Rhesus for fast neutrons was established at about 75 REP, for thermal neutrons at less than 825 REP, and for cobalt 60 gamma radiation at approximately 500 REP. The lesions produced with 500 REP of cobalt 60 could only be observed with the biomicroscope and would probably not cause visual impairment to any significant degree. 850 REP of fast neutrons to the head produced a diversity of ocular lesions.[12] The earliest visible changes in the monkey lens were detected as numerous tiny, white scattered opacities located beneath the posterior capsule. These gradually became more numerous and coalesced to form a dense plaque at the posterior lens pole and then spread laterally. A similar opacity began to occur in the anterior pole. The main central portion of the lens did not begin to show changes until the entire circumference had become totally involved. This has been suggested as an important point in differentiating radiation cataract from senile cataract. From this and other data it is felt that the estimated cataractogenic dose for a man after a single exposure of X-rays lies between 600 and 1400 r and for fast neutrons it is somewhat less than 150 REP. Also noted in these early studies was the presence of cells in the aqueous of some of the animals during the first few hours or days after exposure.[12] It was surmised that if these cells did appear, radiation cataract of some degree would follow at a later date. The latent period and degree of damage corresponded to the severity of cellular reaction. It was also theorized that if no cellular response was noted in the first week, lens opacities that would affect vision probably would not develop.

Recent access to the 184-inch synchrocyclotron at the University of California has

allowed us to extend our studies to the investigation of the effects of protons and alpha particles of high energy. When completed, data will be compared with previous findings regarding fast neutron, thermal neutron and cobalt 60 gamma ray exposures for the relative biological effectiveness.

So far among our earliest findings in this recent study we have found free floating cells in the anterior chamber within the first few hours after exposure. We have also observed that the number of cells varies directly with the dose received, and with the passage of time we will be able to see if radiation cataract will follow as predicted. Validation of this relationship may ultimately prove useful in prognosis of ocular lesions in man after accidental exposure.

We have briefly reviewed the ocular effects of radiation exposure, most of which appear to produce damage with a loss of vision. Nevertheless, we must not overlook its beneficial potentials. The use of ionizing radiation in the therapy of malignant lesions is well established. The recent development of the light coagulator by Dr. Meyer-Schwickerath has provided us with a new tool for treating retinal detachments and fundus lesions. The anticipation that with continued research we can continue to develop newer methods of harnessing these radiations to work for our benefit is indeed reassuring.

References

[1] Byrnes, Victor A., Brown, D. V. L., Rose, H. W., and Cibis, Paul A.: Chorioretinal Burns Produced by Atomic Flash. AMA Archives of Ophthalmology, 53:351, 1955.

[2] Rose, H. W., Brown, D. V. L., Byrnes, Victor A., Cibis, Paul A.: Human Chorioretinal Burns from Atomic Fireballs. AMA Archives of Ophthalmology, 55:205, 1956.

[3] Fixott, R. S.: Research in Effects of Radiation on the Eye. Sight Saving Review, 1960.

[4] Brown, J. L. The Use of Colored Filter Goggles for Protection Against Flash Blindness. NADC-MA-5917, 1959.

[5] Wayne-George Corp., High Speed Electromechanical Goggle. WADC Tech Report 59-114, 1959.

[6] Dreyer, John F., Feasibility Study and Design of Self-Attenuating Light Valve, WADC Tech Report 59-81, 1959.

[7] Metcalf, R. D., Ham, R. E.: Visual Recovery Times from High Intensity Flashes of Light. WADC Tech Report 58-232.

[8] Cogan, David G.: Basic Concepts, Orientation. 63:429, Transactions, Amer. Acad. of Ophth. and Otolaryng., 1959.

[9] Evans, Titus C.: Biological Effects of Radiation and Discussion of Radiological Units. 63:433, Transactions, Amer. Acad. of Ophth. and Otolaryng., 1959.

[10] Brown, D. V. L., Cibis, P. A., Pickering, J. E.: Radiation Studies on the Monkey Eye—Effects of Gamma Radiation on the Retina. Archives of Ophth. Vol. 54-249 259, 1955.

[11] Von Sallman, L.: Early Lenticular Lesions Resulting from Ionizing Radiation. 63:439, Transactions, Amer. Acad. of Ophth. and Laryng., 1959.

[12] Brown, D. V. L.: Atomic Energy and the Eye. Illinois Medical Journal, 113:157-160, April 1958.

Human Ability to Perform After Acute Sublethal Radiation

By

MAJOR ROBERT W. ZELLMER, USAF, MC*

(With three illustrations)

ONE OF the responsibilities of the Military Surgeon which has been receiving increasing emphasis in the past few years is that of technical advisor to the Commander in the field of medical effects of exposure to ionizing radiation. Much of the strategy and logistics of modern warfare is based on the use of nuclear power for propulsion or for weapons. However, such use brings with it the necessity for insight as to its biological effects, both on opposing personnel and for estimates as to the degree of risk involved for those utilizing this nuclear energy. This calculated risk is admittedly a real one and must include the additional hazards of nuclear countermeasures.

Such a short discussion of a complex subject requires that it be limited to a rather narrow range which may be of most interest to the Military Surgeon. First, "acute exposure" will be arbitrarily defined as that dose in r, rem, or rad of radiation which is received within a 24-hour period. Second, the radiation exposure will be assumed to consist of whole-body penetrating external radiation. Third, the population in question will be relatively healthy, young adults. Fourth, the designation of sublethality for the purposes of this paper must include those doses which approximate the LD $^{50}_{30}$ for the species or are somewhat lower. Finally, the performance is understood to be that in the hours or days following exposure and cannot involve the so-called latent effects of radiation exposure. Thus, a typical problem can be formulated: A crew member or ground party is suddenly exposed to, or needs to accept, certain amounts of radiation—say, gamma radiation from a fallout field or from the radiation envelope of an air burst. What can one expect in the way of performance during their mission or at some short time after this exposure?

These rather stringent conditions have been approximated many times in the laboratory using the rat and the rhesus monkey. Furchtgott[1] showed that there was no change in the learning or retention of rats exposed to 200-500 r of total-body x-irradiation. Arnold[2] exposed the heads only of rats to 300-800 r and found similarly that there were no significant changes in the ability to learn or to retain learned tasks. Fields[3] showed that there was little or no change in the performance of rats following exposure to 100-1000 r, although there was a decrease in activity immediately following radiation. This he attributed to a general malaise of the typical acute radiation syndrome. Jones[4] also showed this decrease in activity of the rat following 200-1000 r of whole-body x-irradiation. With the length of time that a rat could swim before exhaustion overtook it as a criterion, Kimeldorf et al[5] demonstrated that the 300-r group did not differ from the controls, but that the 500-r group showed a statistically significant drop in performance. Furchtgott[6] used speed of swimming for rats to demonstrate the same performance decrement at 500 r but not at 300 r. Thus, in the rat where the LD $^{30}_{50}$ is 600-700 r, the first demonstrable performance loss is after exposure to about 500 r of whole-body radiation. This loss is not evident however, in

---

The contents of this paper reflect the personal views of the author and are not to be construed as a statement of policy of the Department of Defense or the Air Force.

* Radiobiology Branch, School of Aerospace Medicine, Aerospace Medical Center, Brooks Air Force Base, Texas.

learning or retention of learned tasks, or in performance of rather complicated tasks which do not require sustained whole-body muscular effort.

The same parameters have been tested in rhesus monkey, with essentially the same results. Using the method of delayed response, Riopelle[7] could not find any difference between the performance of monkeys irradiated with 400 r of whole-body x-rays and that of the normal controls. Leary and Ruch[8] demonstrated the decrease in cage activities of monkeys such as scratching and grooming after 400 r of whole-body x-radiation. McDowell and Brown[9] describe similar results after exposure of the monkeys to doses of bomb spectrum radiation ranging from 544 rem to 709 rem, as well as narrowing of the scope of attention. Kaplan, Gentry and Melching[10,11,12] demonstrated that there is no decrement in retention of highly discriminative tasks in the monkey after sublethal doses of whole-body x-irradition. The studies in the rhesus monkey bear out the general conclusion that sublethal doses of whole-body radiation up to the LD $^{30}_{50}$ dose (about 500 r in the rhesus monkey) may have a general, immediate, mild debilitating effect manifested by a decrease in undirected activities. However, where motivation is high, there is no decrement in performance of highly skilled or discriminative tasks. Further, there has been no experimental demonstration or decrease in ability to learn or to retain knowledge.

That performance in general is not decreased after these relatively low doses of radiation is not surprising in view of the fact that mature muscle and nervous tissue are notoriously radioresistant. Allen et al[13] and Eldred[14] among many, emphasize that in the median lethal dose range, there are no consistent demonstrable neuropathological changes in the monkey. This has been well

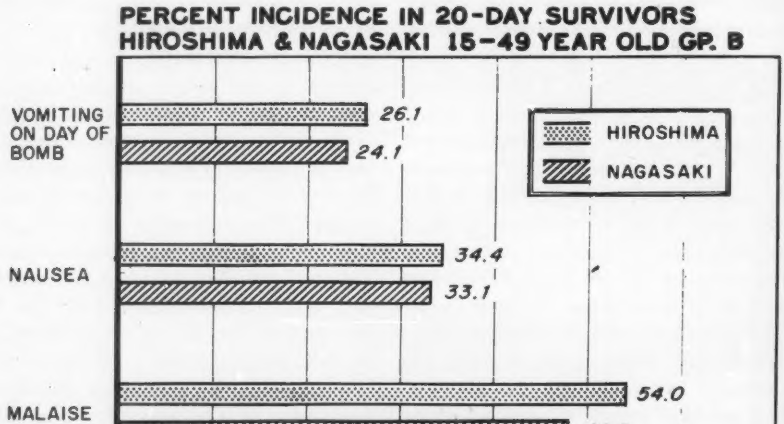


FIG. 1.

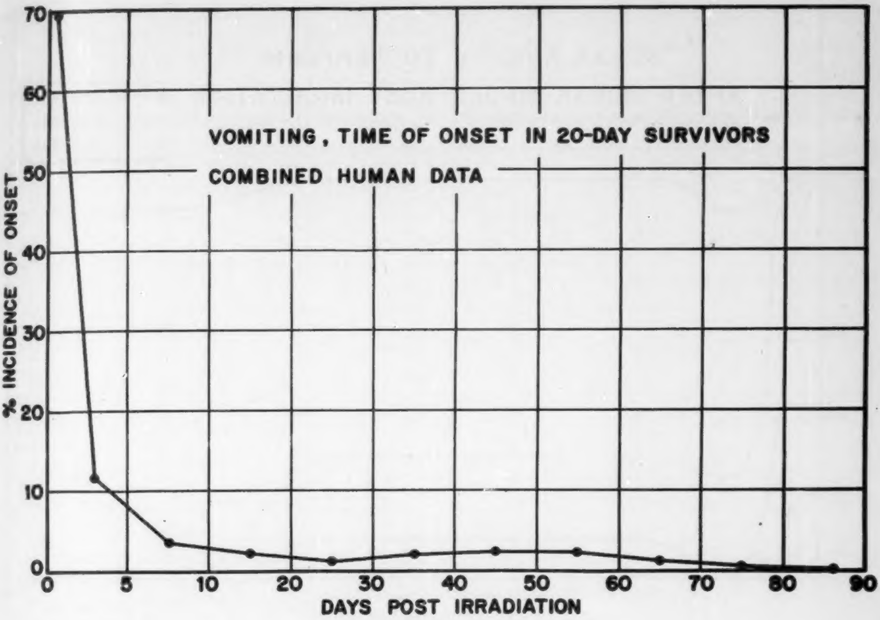


FIG. 2

documented also in the radiation of peripheral muscle of many species, using very high doses before change is observed.

The literature is quite scant relative to the performance of man following exposure to ionizing radiation. In general, one can only glean inferences from clinical reports of such subjective symptomatology as malaise, debilitation, anorexia, weakness, and the like in those who have been accidentally or therapeutically irradiated or from the analysis of the symptoms of the survivors of the Nagasaki and Hiroshima irradiated populations (Fig. 1).

Data which were compiled and analyzed by the Atomic Bomb Casualty Commission (ABCC) are contained in studies by Oughterson and Warren[15] and by Oughterson et al.[16] Among the parameters of the acute radiation syndrome that might have a bearing on the evaluation of the ability of military personnel to perform after acute irradiation are those of nausea, vomiting, anorexia, and malaise. Three factors relative to these symptoms are of interest to us; namely, the time of onset, duration of symptoms and percent incidence. Since these data are restricted to those who survived at least 20 days, they can be assumed to fall within our criteria. Further, as careful an estimation of dose as is possible reveals that the ABCC designation of Group B or ring 2 (1100-1500 meters from the hypocenter) with minimal or no protection best fits the dose criteria of this paper, being about 110-560 rem for the upper and lower limits in Hiroshima and 95 to 580 rem in Nagasaki.

Figure 1 illustrates the percent incidence in 20-day survivors in Hiroshima and Nagasaki of vomiting on the day of exposure, nausea, malaise, and anorexia. It is not at all unreasonable to assume that those who exhibited these symptoms had the higher doses of radiation, and conversely, those survivors who had the lower doses, probably showed a very low incidence of these symptoms. Of these symptoms, vomiting might be considered the only symptom which could be

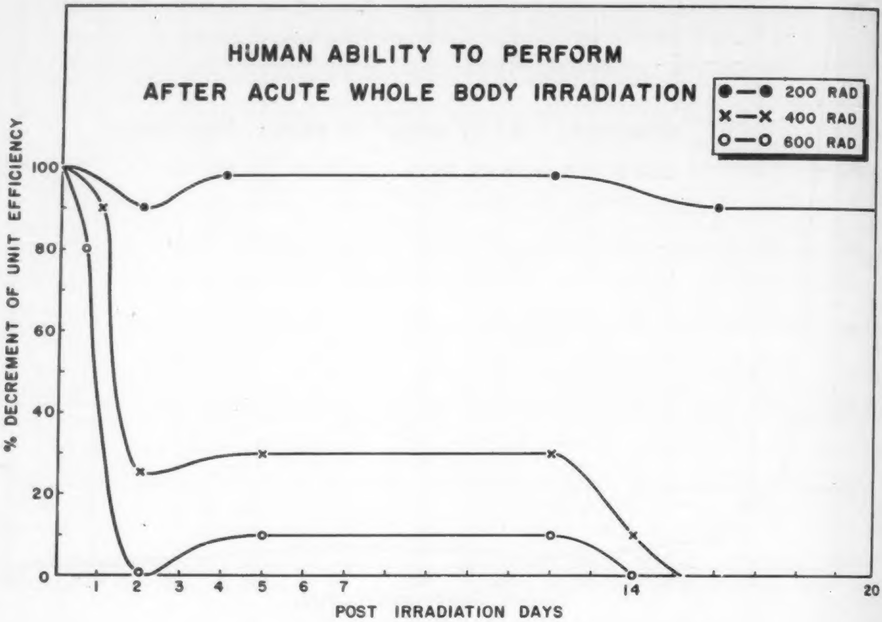


Fig. 3.

truly incapacitating and then only in such a special case as that of a crew member wearing oxygen equipment with possible loss of pressurization, concomitantly with radiation.

Time of onset for all 20-day survivors was ascertained only for nausea and vomiting in this group of four symptoms (Figure 2). In the more severe cases vomiting occurred primarily within the first 24 hours, and in the lower dose groups only nausea and anorexia were noted. This clinical picture correlates well with that described for the monkey. The duration of the symptoms also seemed to be dose dependent, but there the symptom complex begins to be complicated with the added stress of radiation-induced diarrhea, unsanitary conditions, fear, and apathy. Thus no valid analysis of the symptom duration is possible.

Thoma and Wald[17] in an excellent paper have described the clinical signs and symptoms of a group of accidental human exposures. Of the five groups (divided as such by virtue of their symptomatology), probably groups II and III are most amenable for comparison with the other data presented here. The initial and manifest illness phases of these symptoms of the acute radiation syndrome are shown in Tables 1 and 2. Note that in all but three cases the vomiting occurs within 2 hours and in general the higher the dose, the sooner the vomiting occurs and the longer it lasts. Nausea almost exactly parallels the vomiting, as does anorexia. Weakness occurred within the first day in the higher doses and remained through the manifest illness stage; again duration was related directly to dose. Prostration occurred uniformly above the 400 rad dose level. The degree and duration of weakness and prostration is difficult to evaluate from these data, since there are numerous other factors not apparent in the report which could easily affect the clinical course of the disease.

One final study is of importance to this discussion. Payne[18] reports on the performance of patients who had advanced neoplas-

Table 1

Time of Onset and Duration of Clinical Symptoms—Initial Stage*

Pt. No.	Calculated Total Body Dose (rad)	Anorexia		Nausea		Vomiting		Weakness		Prostration	
		Onset	Duration	Onset	Duration	Onset	Duration	Onset	Duration	Onset	Duration
GROUP II											
OR-5	236	2 h	2 d	2 h	2 d	2 d	6 h				
LA-4	242	6 h	12 h	6 h	12 h	6 h	1 h	1 h	70 d	1 d	10 d
OR-4	270	4 h	3 d	4 h	3 d	4 h	2 d				
R-2	300	1 h	4 d	1 h	4 d	1 h	4 h	1 h	4 d	1 h	4 d
OR-3	327	2 h	4 d	2 h	4 d	2 h	4 d				
OR-2	339	2 d	1 d	2 d	<1 h						
Y-6	350	1 h	1 d	1 h	1 d			1 d	>120 d		
OR-1	365	2 h	5 d	2 h	5 d	2 h	2 d				
GROUP III											
Y-5	420	1 h	2 d	1 h	2 d	1 h	2 d	1 d	>120 d		
R-1	450**	1 h	3 d	1 h	3 d	1 h	3 d	1 h	4 d	1 h	4 d
Y-2	500**	1 h	2 d	1 h	2 d	1 h	2 d	1 d	>120 d		
Y-3	580	1 h	2 d	1 h	2 d	1 h	2 d	1 d	>120 d		
Y-4	600	1 h	2 d	1 h	2 d	1 h	2 d	1 d	>120 d		

* Thoma and Wald's Classification. d = day.
** Estimated doses. h = hour.

Table 2

Time of Onset and Duration of Clinical Symptoms—Manifest Illness Stage*

Pt.* No.	Calculated Total Body Dose (rad)	Anorexia		Nausea		Vomiting		Weakness		Prostration	
		Onset (days)	Duration (days)	Onset (days)	Duration (days)	Onset (days)	Duration (days)	Onset (days)	Duration (days)	Onset (days)	Duration (days)
GROUP II											
OR-5	236							44	24		
LA-4	242	6	5					1	70		
OR-4	270							44	42		
R-2	300	24	20					24	20		
OR-3	327							44	42		
OR-2	339							30	56		
Y-6	350							1	>120		
OR-1	365							30	56		
GROUP III											
Y-5	420	32	7	32	7			1	>120	32	7
R-1	450**	19	17					19	22	19	22
Y-2	500**	30	6	30	6			1	>120	30	6
Y-3	580	24	6	24	6			1	>120	24	7
Y-4	600	30	6	32	7			1	>120	30	6

* Thoma and Wald's Classification. ** Estimated doses.

tic disease and who were treated with whole-body radiation. Two experiments were accomplished by the School of Aerospace Medicine in conjunction with the M. D. Anderson Hospital and Tumor Clinic of Houston, Texas. The whole-body x-irradiation doses ranged from 15 r to 200 r given as acute radiation, either in a single dose or in as many as five fractionated doses separated by intervals of no more than one hour. The subjects were pretrained and served as their own baselines in the performance of three coordination tests usually given to pilot applicants (1) USAF SAM complex coordination tests, (2) USAF SAM two-hand coordination test, and (3) USAF SAM rotary pursuit tests. Immediately after irradiation and at later intervals the patients were again tested. The results showed that there was no statistically significant difference between the performances of those patients who had single doses and those who had multiple doses. Of extreme interest to us is that in no case was there a decrement in performance, in learning, or retention of learned tasks that could be ascribed to radiation, even at the 200 r dose.

From all of these data one might attempt some predictions as to the performance of military personnel following acute whole-body doses of 600 rad or less. Three time areas may be considered: the first hour, the first day, and the first week following exposure. For the first hour, all personnel receiving 600 rad or less may be considered 100% effective for performing all tasks. Vomiting in this case will be the only limiting factor and will occur only at intervals such that it should not interfere with prescribed duties.

During the first day the vomiting will have begun to subside and generalized weakness may ensue. Only the 500-600 rad exposures should experience any weakness during this period and their efficiency should not be impaired more than 20% (Figure 3).

By the second day, almost all patients in the 500 and 600 rad groups, and about 50% of the 400 rad group will need to be hospitalized and of those remaining, the efficiency will be lowered by 50%; 25% of the 300 rad group will be in medical channels and the remainder will have lost about 25% efficiency.

After the third day the need for hospitalization will drop off precipitously during the latent phase of the illness, and will not need to be considered for the remaining personnel until about the second or third postirradiation week. For the manifest illness stage, the Commander should plan to lose all personnel who have been exposed to 400 rad or more, about 75% of the 300 rad exposures, and possibly 10% of the 200 rad exposures.

Certainly many other factors such as motivation and individual susceptibility affect performance of troops during wartime or disaster situations, and thus the above predictions can be as much as 100% wrong in individual cases. Much more data from human experience must be accrued before more firm predictions can be made. It is our sincere hope that these experiences never occur, except in controlled therapeutic situations.

References

[1] Furchtgott, E.: Effects of Total-Body X-Irradiation on Learning: An Exploratory Study. J. Comp. Physio. Psychol., 44:197-203, 1951.

[2] Arnold, W. J.: Maze Learning and Retention after X-Irradiation of the Head. J. Comp. Physio. Psychol., 45:358-361, 1952.

[3] Fields, P. E.: The Effects of Whole-Body X-Radiation upon the Psychological Abilities of White Rats. *Abstract,* Amer. Psychologist, 10:415-416, 1955.

[4] Jones, D. C., et al.: Effect of X-Irradiation on Performance of Volitional Activity by the Adult Male Rat. Amer. J. Physiol., 77:243-250, 1954.

[5] Kimeldorf, D. J., et al.: Effect of X-Irradiation upon the Performance of Daily Exhaustive Exercise by the Rat. Amer. J. Physiol., 174:331-335, 1953.

[6] Furchtgott, E.: Behavioral Effects of Ionizing Radiations. Psych. Bull., 53:321-334, 1956.

[7] Riopelle, R. J.: Spatial Delayed Response with Monkeys. J. Comp. Physio. Psychol., 52:746-753, 1959.

[8] Leary, R. W., and Ruch, T. C.: Activity, Manipulation Drive, and Strength in Monkeys Subjected to Low-Level Irradiation. J. Comp. Physio. Psychol., 48:336-342, 1955.

[9] McDowell, A. A., and Brown, W. L.: Some Effects of Nuclear Radiation Exposure on the Behavior of the Rhesus Monkey. USAF School of Aviation Medicine Report 58-58, Apr. 1958.

[10] Kaplan, S. J., and Gentry, G.: Some Effects of a Lethal Dose of X-Radiation upon Memory: A Case History Study. USAF School of Aviation Medicine Project No. 21-3501-0003, Report No. 2, May 1954.

[11] Kaplan, S. J., Gentry, G., Melching, W. H., and Delit, M.: Some Effects of a Lethal Dose of X-Radiation upon Retention in Monkeys. USAF School of Aviation Medicine Project No. 21-3501-0003, Report No. 8, Aug. 1954.

[12] Melching, W. H., and Kaplan, S. J.: Some Effects of a Lethal Dose of X-Radiation upon Retention: Studies of Shock Avoidance Motivation. USAF School of Aviation Medicine Project No. 21-3501-0003, Report No. 9, Aug. 1954.

[13] Allen, R. G., et al.: Acute Effects of Gamma Radiation in Primates. USAF School of Aviation Medicine Report 59-41, Apr. 1959.

[14] Eldred, E., and Trowbridge, W. V.: Neurological and EEG Findings in the Monkey after Total-Body X-Irradiation. EEG Clin. Neurophysiol., 5:259-270, 1953.

[15] Oughterson, A. W., and Warren, S.: Medical Effects of the Atomic Bomb in Japan. In: National Nuclear Energy Series, VIII, New York: McGraw-Hill Book Company, 1956.

[16] Oughterson, A. W., et al.: Statistical Analysis of the Medical Effects of the Atomic Bomb. U. S. Atomic Energy Commission, Technical Information Service, Oak Ridge, Tennessee, 1955.

[17] Thoma, G. E., and Wald, N.: The Diagnosis and Management of Accidental Radiation Injury. J. Occup. Med., I:8, 421-447, 1959.

[18] Payne, R. B.: Effects of Ionizing Radiation on Human Psychomotor Skills. U. S. Armed Forces Medical Journal, X:9, 1009-1021, 1959.

U. S. Army Photo

General Herbert B. Powell, CONARC Commander, inspects the interior of an HU-1A helicopter ambulance during his visit to Brooke Army Medical Center's new heliport. Standing behind him are Major General John F. Bohlender, commander of the medical center (left) and Lieutenant General Donald P. Booth, Commanding General, Fourth Army. The turbine-powered chopper is the latest type in use at BAMC. See page 720.

Burns and Other Trauma Associated With Radiation Exposure

By

COLONEL EDWARD H. VOGEL, JR., MC, *U. S. Army*,*

(With one illustration)

NUCLEAR explosions have introduced new and vastly greater destructive forces than man has previously known. In contrast to conventional high explosive detonations in which the heat generated is of very low magnitude and is almost all expended as blast, nuclear explosions in general release about one-third of their vast amount of energy as thermal radiation, about one-half as blast, one-tenth as residual ionizing radiation or fall-out, and one-twentieth as initial ionizing radiation or gamma radiations and neutrons. It is with the thermal, blast and initial ionizing effects on the body we will concern ourselves in this presentation.

Injury from initial ionizing radiation is a relatively new and poorly understood process and has consequently received by far the greatest attention since the first such injuries were reported at Hiroshima. The treatment of burn injury and mechanical injury has received attention individually but very little has been done in studying the effects and treatment of a combination of these injuries. This paper will attempt to delineate the scope of the problem and to review such scattered data as are available relative to it.

INCIDENCE OF SINGLE AND COMBINED INJURY

A detailed review of the physical effects of a nuclear explosion cannot be undertaken in this paper, but a study of the effective ranges of certain of its effects must be made in order to define the probability of injury. First, it must be stated that the effective ranges of radiation, blast, and thermal effects vary with the power and the location of the nuclear explosion. In this discussion a nominal airburst will be the constant location and I shall enumerate the variation in effects relative to this constant explosion location. Second, effective levels of ionizing radiation, blast and thermal radiation must be defined. The actual lethal dose of ionizing radiation is not well determined for man, but for the purposes of this paper it can be stated that a whole body dose of 300 REM (Radiation Equivalent Mammal) will cause definite radiation sickness to the extent that hospitalization will be required and the clinical course will be serious to grave. If radiation injury is the sole injury, proper supportive care can salvage many of these patients.[3] On the other hand, a dosage of 30 REM is sub-threshold for clinical symptomatology. The discussions in this paper will be concerned entirely with the effect of radiation injury in the sublethal range of 300 REM or less.

Blast effects are more difficult to define in terms of body injuries since the body can withstand rather high values of overpressure. On the other hand, low overpressures, such as 2.5 PSI (pounds per square inch overpressure) will break windowpanes and will accelerate glass fragments to velocities of 180 feet per second. These fragments will penetrate and cause damage to unprotected areas of the human body. It is the secondary effects of blast which lead to much trauma in a nuclear explosion and the 2.5 PSI figure will be used for comparative purposes.

Thermal radiation will cause primary or flash type burns as well as start fires which can cause secondary or flame burns. Since

* Surgical Research Unit, Brooke Army Medical Center, Fort Sam Houston, Texas. Presently Chief of Surgery, U. S. Army Hospital, Okinawa.

TABLE 1

RANGES IN MILES OF VARIOUS LEVELS OF IONIZING RADIATION, BLAST, AND THERMAL RADIATION[4]

Explosive Yield	Ionizing Radiation at			Blast at 2.5 PSI	Thermal Radiation Causing 2° Burn
	30 REM	100 REM	300 REM		
1 KT	0.74	0.62	0.50	0.6	0.48
10 KT	1.07	0.85	0.70	1.3	1.30
20 KT	1.18	0.99	0.80	1.7	1.72
100 KT	1.51	1.29	1.10	2.8	3.40
1 MT	2.07	1.81	1.60	6.0	9.00
10 MT	2.91	2.55	2.20	13.2	23.80
20 MT	3.30	2.88	2.50	16.0	31.90

(Abbreviations used are defined in the text)

second-degree burns are usually as serious as third-degree in a disaster situation and just as incapacitating, the second-degree burn level for thermal radiation will be used for comparison.

Table 1 documents the range in miles of the selected comparative levels of each of these effects at the stated explosive yield. These data indicate that at the 1 KT (KT = kiloton; one kiloton is the equivalent of 1,000 tons of TNT. MT = megaton; one megaton equals 1,000 kilotons) and the 10 KT levels, almost all the casualties concurrently would receive effective injurious dosage levels of each of these modalities. Nuclear explosions of these low yields are most likely to be used in tactical situations and therefore are of great importance to the military. As the explosive power increases it can be seen that effective ranges of ionizing radiation do not increase greatly while those for blast and thermal effects rise sharply. In those situations where casualties sustaining burns or mechanical trauma also fall within the range of effective but sublethal ionizing radiation trauma, combined injuries from two or more of these modalities will result. However, assuming a uniform distribution of people throughout the effective zones, one may visualize in Figure 1 that the number of casualties who may have mechanical and/or thermal trauma combined with ionizing radiation injury will be relatively small when contrasted with the much larger number who would be exposed to mechanical and/or thermal injury without ionizing radiation injury. Therefore, one must not neglect the study of and planning for the care of mass numbers of individuals with mechanical and thermal trauma, although there is a great unsolved problem in the care of injuries resulting from a combination of all three mechanisms.

MECHANICAL TRAUMA AND IONIZING RADIATION

While there have been some conflicting reports as to the effect of whole body irradiation on wound healing,[10] the principle area of conflict seems to resolve about the presence or absence of infection in the open wound. Levenson[7] has demonstrated in the irradiated rat that there is significant delay in wound healing demonstrable only by tensile strength measurements. Wounds will heal, however, if they are closed. It is the open wound or the wound which must be closed secondarily which offers the problem. Following whole body exposure to 100 r (r = roentgen) which has been shown to depress body defenses against bacterial invasion, wound infection as well as an increased incidence of systemic bacterial invasion are to be expected. The results of these various experimental studies would indicate that no surgery should be attempted during the period of radiation sickness.[8] Thus, wounds should be closed before the clinical response to radiation injury has occurred or supported and closed after the host defense mechanisms are again established.

Fractures associated with sublethal doses of whole body irradiation have been studied.[11] If the fractures are not compounded, healing has been shown to progress uneventfully except during the period of actual radiation sickness when the callus will soften and external fixation must be maintained to prevent increased morbidity or un-

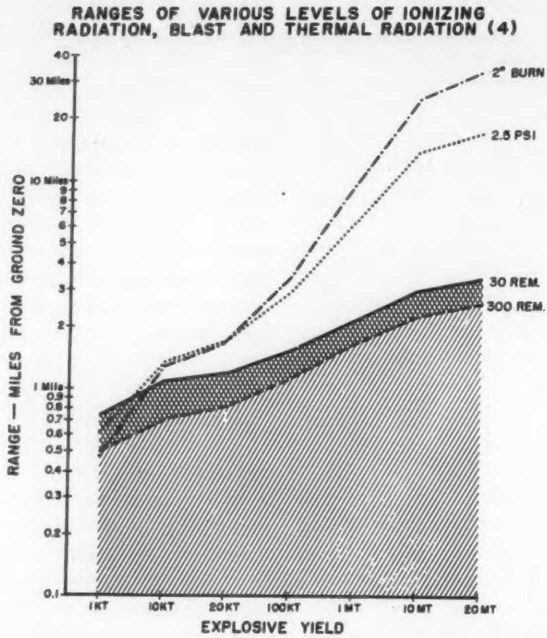


FIG. 1. Range in miles of stated levels of ionizing radiation, blast and thermal radiation for various levels of yield of nuclear explosions.

desirable sequellae. Upon recovery from radiation sickness, healing progresses uneventfully.

Thermal Injury and Ionizing Radiation

The distribution of casualties from nuclear explosions as determined by surveys of the initial survivors of the nuclear explosions at Hiroshima and Nagasaki are recorded in Table 2. The total exceeds 100 per cent so it is evident that there were many combined injuries among the casualties.

TABLE 2

DISTRIBUTION OF TYPES OF INJURIES AMONG INITIAL SURVIVORS AT HIROSHIMA AND NAGASAKI[4]

Injury	% of Survivors
Mechanical	70
Burns	65–85
Ionizing radiation	30

Furthermore, 90 per cent of all persons requiring medical attention in the first week after these explosions were burned.[9] Most patients with third-degree burn of any great extent did not survive to get to medical treatment facilities, so that 90 per cent of the burned patients in the aid stations and hospitals after these explosions had second-degree burns.[6] Yet over 50 per cent of all deaths in these survivors had burns.[4] Brooks[2] stated in his study that the mortality in burn injury among the Japanese was so high that it was difficult to explain on the basis of the thermal injury alone, even in the presence of inadequate hospitalization facilities, poor sanitation and malnutrition. Studies have therefore been made by several investigators in an attempt to delineate the effects of thermal injury and sublethal doses of whole body irradiation. These investigations are summarized in Table 3.

TABLE 3

MORTALITY IN EXPERIMENTAL COMBINED WHOLE BODY IRRADIATION AND THERMAL INJURY

Investigator and Experimental Conditions	Animal Used	% Mortality
1. Brooks et al[2]	Dogs	
20% body burn alone		12
100 r alone		0
20% burn+25 r		20
20% burn+100 r		73
20% burn+100 r+penicillin		14
2. Alpen et al[1]	Rats	
250 r alone		0
31–35% body burn alone		50
31–35% body burn+100 r		65
31–35% body burn+250 r		100
3. Korlof[5]	Guinea pigs	
1.5% body burn only		9
250 r only		11
1.5% body burn+250 r		38

Brooks's studies[2] are of interest as they record that the addition of only 25 r of whole body irradiation to a 20 per cent body burn in the dog doubled the mortality, while the addition of 100 r increased the mortality by a factor of 6. The addition of penicillin therapy to the burn plus 100 r group reduced mortality to the level of the burn alone. This is an indication that depression of defense mechanisms by radiation injury probably is the greatest factor causing the increase in mortality from combined injury.

Korlof's work[5] showed that even small burns can be lethal and that mortality in combined injury is certainly more than an additive effect. The burn alone in guinea pigs gave a mortality rate of 9 per cent and 250 r of whole body radiation alone gave a mortality rate of 11 per cent, which added together gave a total mortality of 20 per cent. Nonetheless, when these two injuries were combined in the same animal, a 38 per cent mortality resulted, which was twice as large as the combined mortality of the two control groups. In concurrent studies carried out on these animals, Korlof demonstrated that 250 r caused a marked reduction in white blood cell count and hemoglobin, maximal at about nine days postirradiation. Bacteremia was common in the animals having both burn and irradiation, occurring usually between the 8th and 14th day postirradiation. There was rather good correlation of the bacterial species recovered from the blood and those which were found on the burn wound surfaces. Radiation did not seem to influence the healing time of the burn wounds. This investigator was also able to show that in experimental infection of burn wounds with *Pasteurella*, the presence of combined injury led to more rapid bacteremia and death. However, these animals could be protected by the use of streptomycin which was effective against the organism used in the study.

DISCUSSION

Thermal burns and mechanical trauma will cause far more morbidity and mortality in individuals who initially survive large nuclear explosions than will radiation injury. Even so, there will be a sizeable number of injured who will sustain combined injuries of sublethal radiation plus thermal and/or mechanical trauma. This is so because the effective range of thermal and mechanical effects is far greater in all nuclear explosions except in those of less than 10 KT yield.

Combined mechanical trauma and sublethal radiation injury offers no insurmountable barrier to survival if most of the surgical procedures can be accomplished early and the patient be well on the road to healing prior to the onset of depression of the defense barriers against infection secondary to radiation exposure. Wound healing *per se* is not significantly retarded by sublethal doses of irradiation. One should plan, however, to do surgery before or after but not during the acute radiation syndrome.

Combined thermal injury and sublethal radiation is the great unsolved problem. All of the limited investigations to date indicate that this combination of trauma will result in mortality rates two to six times greater than either injury alone or their added mortality. This multiplying mortality is in all

probability due to the presence of a chronic open burn wound associated with the usual, somewhat debilitated state of the burned patient plus a depression of the body defense mechanism against infection which is associated with the radiation effect. Thus, burned patients with sublethal radiation exposure die as the result of invasive bacterial infection. While antibiotics may benefit animals, experience with human patients without radiation exposure does not indicate that infection will be controlled in this manner. One is, therefore, faced with the need for new methods of management of burns which will obtain skin coverage before the onset of radiation illness, or a method of preventing or effectively treating radiation injury, so that the body defense mechanisms will not be destroyed. To date we have no answer, and to me this is a field which urgently requires a concerted, maximum effort if we would hope to salvage a large number of casualties following disaster due to nuclear explosion.

Summary

The characteristics of nuclear explosions which indicate that the incidence of thermal and mechanical trauma will be high in such a situation have been recorded. A smaller but significant portion of these casualties will incur concurrent sublethal ionizing radiation in the range of 30 to 300 REM.

Mechanical trauma and fractures associated with radiation injury will probably not create great difficulty if proper planning and execution of surgery and the judicious employment of antibiotics is utilized.

Burn injury associated with sublethal radiation injury will be associated with mortality rates two to six times greater than that expected from either of the causative factors alone. Invasive bacterial infection due to radiation depression of host defense mechanisms is thought to be the reason for this increase. Antibiotics are not expected to control these infections. An urgent need for intensive investigation of methods to circumvent this outcome exists.

References

[1] Alpen, E. L., and Sheline, G. E.: The Combined Effects of Thermal Burns and Whole Body X-Irradiation on Survival Time and Mortality. Ann. Surg. 140:113-118 (1954).

[2] Brooks, J. W., Evans, E. I., Ham, W. T., Reid, J. D.: The Influence of External Body Radiation on Mortality from Thermal Burns. Ann. Surg. 136:533-545 (1952).

[3] Gerstner, H. B.: Acute Radiation Syndrome in Man. Armed Forces Medical J., 9:313-354 (1958).

[4] Glasstone, Samuel: The Effects of Nuclear Weapons. DA Pamphlet No. 39-3 (May, 1957).

[5] Korlof, B.: Infection in Burns, Acta Chirurgica Scand. Supplement 209, pp. 117-139, Stockholm (1956).

[6] LeRoy, G. V.: The Medical Sequella of the Atomic Bomb Explosion. J. Am. Med. Assoc., 134:1143-1148 (1947).

[7] Levenson, S. M., Oates, J. F., and Geever, E. F.: Effects of Whole Body X-Irradiation on Wound Healing. Surgical Forum, Vol. X, pp. 840-844 (1960).

[8] Moncrief, W. H., Jr.: Trauma and Whole Body Radiation. Symposium on Current Surgical Practices, Walter Reed General Hospital (April 1960).

[9] Pearse, H. E., and Payne, J. T.: Mechanical and Thermal Injury from the Atomic Bomb. New Engl. J. of Med. 241: 647-653 (Oct. 27, 1949).

[10] Radokovich, M., Dutton, A. M., and Schilling, J. A.: The Effect of Total Body Irradiation on Wound Closure. Ann. Surg. 139:186-194 (1954).

[11] Spittler, A. W., Butch, J. W., and Rutledge, B. A.: Whole Body Irradiation on the Healing of Fresh Fractures. AMA Arch. of Surg. 68:93-104 (1954).

Clinical Management of Patients Exposed to Radiation Disasters— An Outline

By

CAPTAIN E. R. KING, MC, *U. S. Navy**

IT IS doubtful if it is theoretically possible for a radiation disaster to occur of the magnitude described in the novel, "On the Beach." However, it is probable that small scale disasters will continue to occur, such as the Windscale (England), Yugoslavian, Y-12 (Oak Ridge) and Los Alamos accidents, and moreover, it is likely they will occur with increasing frequency as more and more power reactors and nuclear weapons are assembled. It is likely that every major metropolitan area in this country will have in its vicinity a potential source of radiation that could expose a large portion of the population to detrimental doses of ionizing radiation.

This is an outline expressing the current thinking of how to care for patients involved in such a peacetime radiation accident or incident. The plan could also be applied to wartime conditions. The National Naval Medical Center has been designated as the Radiation Disaster Treatment Center for the Navy, and the new Radiation Exposure Evaluation Laboratory is the nucleus of this Center. The presented plan will utilize these facilities.

Table 1 demonstrates the radioactivity present in a nominal size power reactor after four months of operation with twelve hours of cooling following an excursion, or "runaway." The total activity present is hundreds of thousands of times that of the world's supply of radium. About 50% of this might escape if the container of the fuel core of the reactor ruptured, and of this amount, 80 million curies would be in the form of volatile fission products.[1] It is possible that much of this liberated radioactivity could escape into the atmosphere as in the Wind-

TABLE 1

RADIOACTIVE YIELD FOR A 500 MW POWER REACTOR, AFTER 180 DAYS OF OPERATION AND 24 HOURS OF COOLING

(This size reactor would be adequate for power to a city of about 1 million population.)

Total fission products	4.1×10^8 curies
Strontium-90	3×10^5 curies
Cerium	8×10^6 curies
Strontium-89	1.7×10^7 curies
Plutonium-239	3.8×10^3 curies
Iodines	5×10^7 curies
Noble gases	3.4×10^7 curies
Total volatile fission products	8.4×10^7 curies

(In a violent reaction—50% of total activity would escape, about 20% of which would be volatile.)

TABLE 2

PATIENT EVALUATION AT ACCIDENT SITE

I. Survey of accident site by RadCon Team, type of, and severity of accident.
II. Determination of possible types of exposure.
III. Determination of probable radiation exposure dose.
IV. Segregation and evacuation of known exposure cases.
V. Obtaining of positive identification and permanent addresses of individuals at the exposure site who did not require evacuation. Follow-up studies on these people are mandatory.

(It will be difficult to evaluate the extent of exposure. If in doubt and the number of cases is small (20 or less), the safest procedure is to evacuate all cases.)

*Chief, Radiology Service, U. S. Naval Hospital; Director, Department of Nuclear Medicine, U. S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland.

Presented in part at the Eighth Annual National Medical Civil Defense Conference at the Americana Hotel, Miami Beach, Florida, June 11, 1960.

TABLE 3

ADMISSION ROOM MANAGEMENT OF RADIATION DISASTER VICTIMS

I. *Ambulatory Patients (uninjured)*

1. Monitor patients with clothes on. If not obviously contaminated, allow patients to temporarily leave area for later consideration.
2. If contaminated, remove clothing and dispose of clothing.
3. Refer patients to decontamination area for thorough washing under shower with a detergent and scrub brush.
4. Dry in shower room.
5. Monitor outside shower room. If still contaminated, repeat shower (clip hair, if necessary).
6. Dress in pajamas.
7. Go to area designated by doctor on duty.
8. Be available for further studies indicated by type of exposure (low background total body counting, hematological studies, radioassays of excreta, etc.).

II. *Ambulatory Patients (injured)*

1. If patient has first aid or temporary dressings, remove same and monitor as though he were uninjured.
2. If further first aid is needed, perform same.
3. If the bandages or first aid dressings that have been applied are soiled, etc., it might be necessary to remove the top layers and monitor as previously stated.
4. If the patient is contaminated, remove clothes, remonitor and dress in pajamas. Carry out any emergency treatment required.
5. If the patient is grossly contaminated and could withstand a cleansing shower, perform this procedure, then dress in pajamas and admit to the hospital. Perform additional studies as indicated by the type of exposure.

(See I, 8)

III. *Stretcher Patients (non-critical)*

1. Monitor patient. If not contaminated, remove clothing, apply pajamas and admit to hospital as a probably non-contaminated person.
2. If contaminated, remove clothing, take the patient to tub sink or tub bath, decontaminate as much as possible, dress in pajamas, and admit to hospital. Perform additional studies as indicated by type of exposure.

(See I, 8)

IV. *Stretcher Patients (critical)*

1. Administer necessary first aid.
2. Monitor as thoroughly as possible.
3. If they do not appear contaminated, treat as any other non-contaminated, critically injured stretcher patient, then admit to hospital.
4. If contaminated and in critical condition, wash surface area as much as possible and admit to hospital. Perform additional studies as indicated by type of exposure.

(See I, 8)

V. All representative of the press will be referred to the Administrative Officer. Patients and attending physicians, nurses and technicians will not be subjected to interview by the press.

scale accident.[2] If the reactor were water cooled it might escape into surrounding bodies of water.

Table 2 outlines immediate procedures to be carried out once an accident has been reported. The Navy has established two Radiation Disaster teams, one on each coast, that are to report immediately to the site of a radiation accident in which Navy reactors or weapons are involved. The function of the team is that of an advisory capacity to the military establishment nearest the accident site. Under present plans, personnel involved and known to be exposed to a radiation dose-rate above the maximum permissible dose levels advocated by the National

Committee on Radiation Protection, will be evacuated to the National Naval Medical Center, Bethesda.

Upon arrival, the patients will be evaluated as to their physical condition and external radioactive contamination according to Table 3.[3,4]

Table 4, 5, and 6 outline the criteria used in deciding upon the management of these cases.

In Table 4 prognosis would not be considered under management unless the accident were of such a scope as to saturate available facilities with disaster victims. For small scale disasters which would result in a score or so of patients, all possible medical and nursing aid would be offered each case.

In Table 5 an estimate of prognoses based upon radiation dosage is listed. These doses are applied to patients who will be afforded optimal medical aid, and not to patients who would be injured in a large scale accident, or war. In the latter cases, the doses listed would be lowered by about 20%. In other words, patients receiving random medical care cannot withstand as much radiation.

Table 6 presents a description of the possible methods of exposure from which patients may suffer from various types of radiation accidents. These facts should be obtained from the disaster site survey and will decide, as can be seen from the rest of this paper, what type of management would be indicated for certain types of exposure.

Tables 7 and 8 outline the management of the "general" type of exposure according to the radiation dose received as listed in Table 5.

Most of the management is in the form of supportive therapy. If any specific therapy is to be offered, it would be in the form of bone marrow transplants, but some workers

TABLE 4

MANAGEMENT OF RADIATION ACCIDENT PATIENTS

Depends upon:

I. Types of exposure.
II. Radiation dose.
III. Prognosis (true only when large numbers are exposed to large doses of the external type).

TABLE 5

PROGNOSIS OF PATIENTS EXPOSED TO EXTERNAL RADIATION

Group I. Survival Probable—100-300 rem. Use supportive therapy as indicated. (Probably none will be needed.)

Group II. Survival Possible—300-750 rem. Major effort should be devoted to this group.

Group III. Survival Improbable—750 rem. upward This group (750-1400 rem.) may be saved by autologous bone marrow (perhaps homologous also). Doses over 1500 rem. are likely fatal.

(Doses are for gamma and/or x-ray. If exposure includes neutrons, the above doses should be lowered by 10-20%.)

TABLE 6

TYPES OF EXPOSURE

I. "General" exposure—external type, i.e., gamma, x-ray, neutrons. This produces a "general" systemic reaction.
II. "Superficial" exposure—external type, i.e., soft energy gamma or x-ray, beta particle radiation. Most of reaction is "superficial," with little "general" reaction.
III. Induced radiation exposure—external neutrons—reaction is "general" from radioactivity induced by the neutron flux.
IV. Internal contamination—radioactivity deposited inside the body.

TABLE 7

EARLY MANAGEMENT OF "GENERAL" EXPOSURES

(first 10 to 14 days)

I. Good nursing care—all groups.
II. High caloric and protein—low residue diet with supportive vitamins—Groups II and III.
III. Fluid and electrolyte balance maintenance—(preferably by oral route)—Groups II and III.

(Routine and special laboratory studies should be performed upon all radiation exposure patients. The scope depends upon the capabilities of the available laboratories. Aliquots of 24 hour urine collections should be frozen for special studies elsewhere.)

TABLE 8

LATE MANAGEMENT OF "GENERAL" EXPOSURES

(after 14 days—for Groups II and III)

I. Meticulous nursing care.
II. Adequate diet—modify according to clinical status.
III. Continue to maintain fluid and electrolyte balance—orally, if at all possible.
IV. Fresh whole blood if needed.
V. Platelet transfusion—if hemorrhagic diathesis present or imminent.
VI. Bone marrow transfusion (or transplants).
VII. Antibiotics if indicated.

(It should be noted that the Group I patients are not included in the table for *late* management, as they probably will require no special care after about two weeks post-exposure time.)

feel that this treatment is also supportive.

The use of autologous (from same individual) bone marrow transplants is very promising, and if a method could be developed to preserve autologous bone marrow for a prolonged period, it might prove life-saving if a disaster occurred. Homologous (from another individual, or donor) marrow has not proven as efficacious and there is some doubt as to the authenticity of "takes" of homologous marrow by irradiated patients.

The use of antibiotics is discussed in Table 9. As in most other therapeutic measures for patients exposed to "general" types of radiation, common sense and good judgment are most important in deciding what antibiotics to use and when to use them.

TABLE 9

USE OF ANTIBIOTICS IN "GENERAL" EXPOSURES

I. Prophylactic use not indicated.
II. For Groups II and III—culture naso-oropharynx, stools and urine. Select broad spectrum antibiotics for pathogens demonstrated by cultures.
III. When signs and symptoms of infections are present, give large doses of the selected antibiotics.
IV. For localized infections use customary hot soaks, etc.
V. Mass casualty situation—do as best you can with what you have.

TABLE 10

MANAGEMENT OF "SUPERFICIAL" RADIATION EXPOSURE

I. Good nursing care—sterile technique in dressing areas of vesiculation and weeping.
II. Applications of bland lotions (non-oil base) to areas of irritation and weeping.
III. Debridement when indicated.
IV. Plastic surgery as indicated.
V. Supportive therapy for general systemic reactions. In general, the same treatment as thermal burns.

(This exposure may result from rupture of a reactor core or weapons' casings, fall out or rupture of sealed sources.)

Table 10 discusses management of the "superficial" type of radiation exposure. Here the patient is cared for in a manner similar to thermal burn cases, and are usually similar to burns of a first or second degree nature.

Table 11 and 12 include discussions of more specific measures required to care for patients exposed to a neutron flux, and/or to those in whom radioactive materials have been deposited in their bodies.

If neutron exposure occurred, most likely external gamma ray (photon) exposure would have also occurred, and the management would be the same for the "general" exposure patient.

Under the above two headings, specific studies should be made that are not required for "general" or "superficial" forms of radiation exposure. These include urine radio-

TABLE 11

MANAGEMENT OF THE INDUCED RADIATION CASE

Depends on:

I. Dosage. If high, groups listed under "general" management may be followed.
II. Adequate measurement of induced radioactivity, by
   a. Whole body counting.
   b. Urine, blood and tissue radioassays.

(This type of exposure is most likely to occur during a reactor accident (or "excursion").)

assays for induced radioactivity (elements of the body made radioactive by neutron collision, such as Na^{24}, P^{32}, etc.) and for urine studies of excretion of internally deposited contamination (Pu^{239}, Sr^{90}, I^{131}, H^3, etc.).

One of the most important special studies to be performed, as listed in Tables 11 and 12 is the whole body counting of these patients. By this procedure one can determine the total radioactivity in the patient's body, the types of radioactive materials present, and quite likely, the organ or organ systems in which this radioactivity has been deposited.

There has been no discussion of methods of estimating the radiation dose, although it is recognized this factor is of primary importance in evaluating and managing radiation disaster patients. It has been pointed out that the prognoses of these cases, as well as treatment, depends upon the dosage determinations (Table 5). Discussion of dosimetry can become very technical and it is not believed such details should be included in a general discussion such as this. It may be stated that at this time attempts to determine radiation dosages received during radiation accidents by physical and electronic methods has not been too satisfactory. Apparently the peripheral blood count, coupled with special biochemical studies of the urine (determination of taurine and beta-aminoisobutyric acid) may prove the best criteria for dose estimation.[4] The clinical signs and symptoms of the patient are also of extreme importance.

TABLE 12

MANAGEMENT OF CASES WITH INTERNAL CONTAMINATION

Depends on:

I. Proper evaluation of circumstances of exposure.

II. Attempt to measure "body burden" (whole body counting, radioassays of urine, etc.).

III. Mobilization of contaminants by chelating agents.

IV. Removal of contaminants from blood stream by the artificial kidney.

(This type of exposure may evolve from ingestion, inhalation or injection (into wounds, etc.) of radioactive contaminants, resulting from nearly any type of accident.)

REFERENCES

[1] *Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants.* USAEC; Washington, D.C. 740, March 1957. Supt. of Documents, U. S. Government Printing Office.

[2] *Accident of Windscale No. 1 Pile.* British White Paper, British Information Sales Section, 45 Rockefeller Plaza, New York 20, N.Y.

[3] NH Beth Instruction 6470.4 dated 10 March 1959. U. S. Naval Hospital, Bethesda, Maryland.

[4] King, E. R.: Management of Victims of a Radiation Accident. So. Med. J., 53:432, April 1960.

OXYGEN FOR THE ASTRONAUT

Oxygen manufactured in flight for the astronaut is possible through the use of a photosynthetic gas exchanger using solar energy. Lt. Colonel John B. Fulton, Commander of the U. S. Air Force Arctic Aeromedical Laboratory at Fort Jonathan Wainwright, Fairbanks, Alaska, has presented the Surgeon General of the Air Force with a working model of the device.

Employing *algae chlorella* which uses the carbon dioxide exhaled by the astronaut in the space vehicle and, with the assistance of energy from the sun, the exchanger converts the carbon dioxide into oxygen.

Anti-Radiation Drug Developments

By

David P. Jacobus, M.D.,

and

Major Michael P. Dacquisto, MC, *U. S. Army**

In a nuclear war there are several general situations under which an Army operating in the field might receive considerable radiation injury. Anti-radiation agents, therefore, merit consideration. The radiation from a nuclear detonation and fireball is emitted sufficiently promptly that an anti-radiation pill taken by mouth would not be effective unless sufficient warning had been given so that the pill could be taken in advance. In a military situation nuclear detonations might be anticipated, thereby allowing the use of chemical preprotection; but, even in cases where such detonations were not expected, an anti-radiation agent would still be useful, especially if the attack involved large weapons producing fallout. In fact, the incapacitating effect of the burn and blast injuries associated with large weapons is sufficiently great that the immediate radiation injuries suffered by exposed populations are a relatively minor aspect of the effect of large weapons. For personnel who are protected by shelter and therefore probably warned of an impending attack, the use of an anti-radiation agent is obviously of much greater value. Weapons producing fallout which covers large areas and persist for a long period of time would also have a profound tactical and medical influence. Such fallout injuries are due purely to radiation; reduction of radiation could therefore result in an effective increase in survivors.

I would like to indicate the present status of anti-radiation agents. The Army Medical Research and Development Command has initiated a drug development program, similar to that under which anti-malarials were developed, in order to find an anti-radiation agent useful for protecting man against radiation injury. The goal of this program is *not* to develop an agent more effective than those already available. Rather, the goal of this program is directed toward the reduction of toxicity by standard techniques of drug development. We are, therefore, not searching for agents which will operate by a new principle. During the past year new agents have been synthesized which do offer protection to mice at levels well below the maximum amount tolerated. We are in the process of evaluating these new agents in large animals but have no data for these as yet. The first mixtures used in dogs caused about a ten percent acute mortality from the drugs alone. The latest mixtures to be described shortly are nonlethal and a dog under their influence is able to walk around and do mild exercise. While we are making progress, we are not yet ready to administer these agents systemically to people.

At the start of the Army program about 1500 compounds had been evaluated for possible anti-radiation action, mainly by the U.S. Air Force Radiation Laboratory in Chicago. Of this number the best were the 56 having a potential sulfhydryl group two or three carbons aliphatically removed from some alkaline nucleus. Accordingly, the Army Anti-Radiation Drug Development Program has limited itself to this series. (The present compounds and the important lines of development are listed in Table 1; the first four types are receiving the most intensive development.) Approximately 160 of these specific types have been received along with 400 related compounds and 300 miscellaneous compounds. Forty-six percent of the specific compounds have shown significant activity.

* Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C.

Table 1. Compounds Being Developed

Parent Compounds Being Developed

$H_2NCH_2CH_2SH$

$H_2NCH_2CH_2CH_2SH$

$H_2NC(=NH)NHCH_2CH_2SH$

$H_2NC(=NH)NHCH_2CH_2CH_2SH$

$H_2NC(=NH)CH_2CH_2SH$

Major Derivatives

- Alkyl
- Aryl
- Hydroxy alkyl
- Amino alkyl amino
- Alkyl halo
- Carbohydrate
- Sat. and unsat. heterocycle
- Metallo-organic

We feel this is a good percentage for a development program.

The present effectiveness in dogs of these chemicals against radiation injury is indicated in Table 2. These dogs were exposed to 3 mev X-radiation delivered at 100 to 200 roentgens per minute. All dogs shown as having survived more than 60 days are still alive. The first dogs were protected 27 months ago. Judging by the percentage of survivors and the average survival time, the dogs receiving the chemical protection were provided with at least a 50 percent reduction in the amount of injury which the control dogs sustained. Although it might appear from a superficial inspection of the data that a greater reduction in radiation injury was provided by the chemicals, there are so few animals involved in the test that we feel reluctant to claim a greater degree of protection. The chemicals used to protect these dogs were all given intravenously. The survival time data is a composite of the results obtained from several different mixtures of protective drugs. These mixtures contain at least two mercaptans plus a methemoglobin producing agent and a cytochrome oxidase inhibitor originally discovered at the USAF Radiation Laboratory. The protective mixture used to obtain most of the data shown in Table 3 was a combination of p-aminopropriophenone 5 mg/kg and p-hydroxydiphenyl 10/mg/kg intravenously one hour before radiation followed by a mixture of mercaptoethylamine 100 mg/kg and cysteine 300 mg/kg just before exposure. No dog has died from the above mixture of chemicals, but they certainly suffer observable side reactions, the most important being emesis, hyperactivity, methemoglobinemia and some hypotension. It is with the expectation of eliminating these side effects that the Army program has been established.

The lengthening of the effectiveness of the anti-radiation agents reported above is an additional problem which also must be solved before a widely useful agent is available. We feel we would be able to solve this quite easily in comparison with the problem of reducing the toxicity of the agents by such techniques as slow release pills and the addition of lipophilic groups. Our present agents are effective by mouth in mice and dogs for only four or five hours. I would like to point out that compounds which are effective for only this short period of time would still be useful if taken just before entering an irradiation area.

Table 2. Present Effectiveness of Chemicals Against Radiation Injury

Radiation Dose (r)	No. Dogs	% Survival	Mean Survival Time (Days)
No Treatment			
200	10	100%	More than 60
300	10	80%	16
350	10	40%	14.2
400	28	7%	13.3
450	10	0%	12.4
775	95	0%	10.9
1500	39	0%	4.2
Chemical Pretreatment			
775r	23	100%	More than 60
1500	28	7%	12.6

We would like to emphasize that while our goal is virtually complete absence of toxicity to insure the most useful military application of these agents, lesser degrees of success in reducing toxicity will also solve important military problems. In general, the risk of impending radiation exposure is directly related to the amount of toxicity that is acceptable. When exposure is certain heroic treatment countermeasures may be life-saving in spite of temporary acute morbidity. On the other hand, when the risk of exposure is minimal one is reluctant to advise treatment which will lead to certain morbidity.

Abstract

IN VITRO ADSORPTION OF POLIOVIRUS BY NONCULTURED TISSUES; EFFECT OF SPECIES, AGE AND MALIGNANCY*

Calvin M. Kunin, M.D., and William S. Jordan, Jr., M.D.
Departments of Preventive Medicine and Medicine, University of Virginia School of Medicine, Charlottesville, Virginia.

(American Journal of Hygiene, May 1961)

Poliomyelitis is usually considered to be an infection limited to the gastrointestinal tract, lymphatic and central nervous systems in the intact animal; yet cells derived from almost any tissue of a susceptible primate host will support the multiplication of the virus *in vitro.* The prime importance of specific receptor in determining susceptibility of cells to enteroviruses has been demonstrated by McLaren, Holland and Syverton (J. Exp. Med. *109*:475-485, 1959). The current studies were undertaken to test the hypothesis that the ability of a particular tissue to support the multiplication of a specific virus *in vivo* (and thus exhibit tropism) is related to the relative abundance of cells in that tissue which possess receptor sites for the virus in question.

Adsorption experiments were conducted with noncultured minces and homogenates of monkey, mouse and human tissues. Poliovirus, type 1, Mahoney strain was employed and assays were conducted by a plaque method employing HEp-2 cells.

All surveyed tissues of rhesus monkeys, particularly brain, actively adsorbed virus, as did tissues of a 3 month human fetus, human carcinomas, and tonsil tissue. No activity could be demonstrated using mouse tissues or human term amnion. The factor in tissue responsible for virus adsorption was destroyed by heating at 56°C, and, as studied in monkey brain and liver, was inactivated by treatment with ether and trypsin. Study of many other human tissues was hampered by the presence of a heat stable factor, presumably residual specific antibody, which could not be washed from the preparations.

The foregoing observations support Wenner and Kamitsuka's findings (Virology *2*: 83-95, 1956) of widespread infection in many organs of cynomologous monkeys during the early incubation period following injection of poliovirus. Abortive infection in organs such as heart, muscle, and liver would be explained, according to the current hypothesis, as due to exhaustion early in infection of the few cells in these tissues possessing receptor site. Organs containing either greater number of susceptible cells or cells whose destruction produces dramatic clinical signs (anterior horn cells) would appear clinically to be the primary sites of virus reproduction. The studies with human term amnion raise the question as to the mechanism by which these cells become susceptible to poliovirus when cultivated *in vitro.* Do all amnion cells gain susceptibility by "acquisition" of receptor site or by the selection of susceptible cell clones during *in vitro* growth? Further studies designed to answer some of these questions are now underway.

* This investigation was conducted under the auspices of the Commission on Acute Respiratory Diseases of the AFEB, and was supported in part by the Office of The Surgeon General, Department of the Army, Washington 25, D.C.

The Nuclear Age and Nursing Technology

By

LIEUTENANT COMMANDER LENORE SIMON, *NC, U. S. Navy**

AS ONE reviews the pages of history, he finds that radioactivity has been present in our environment since man has existed on the earth. Directly or indirectly, the presence of radiation has influenced the changes that have taken place. It has been stated that progress is possible only when man himself is capable of adapting to or controlling his environment. This fact is seen in the scientific and technological progress achieved in this century. Dramatic, new dimensions in the application of nuclear energy for military and peacetime purposes have evolved. In recent years, man-made ionizing radiation has made us acutely aware of additional radiation sources in our environment. This awareness presents a need to place greater emphasis on planning and preparing all disciplines for the progress, problems and potentialities resulting from nuclear age developments. It takes but little imagination to appreciate that these advances directly affect nursing practice and preparation. The nursing profession is specifically challenged to expedite attainment of additional knowledge in certain areas in preparation for skillfully assuming expanding nursing responsibilities and maintaining effective health team membership. Selected medical applications for radioisotopes are briefly reviewed, and other nuclear age frontiers are highlighted to serve as a springboard for this discussion. I hope this orientation will indicate a realistic and practical necessity for expanding nursing curricula so that essential educational needs may be met.

The views expressed are those of the author and do not necessarily reflect those of the Naval Service at large.

Presented at the 67th Annual Meeting, Association of Military Surgeons of the United States, Washington, D.C., October 31, 1960.

* Head, Division of Nuclear Nursing, Dep't., of Nuclear Medicine, U. S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland.

MEDICAL APPLICATIONS

The excellence of all health programs is related to scientific progress. As a result, new medical techniques are constantly being devised for extending preventive health measures and curative practices.

The present use of clinical radioisotope laboratory procedures represents one of the newest and most specific methods for the detection and diagnosis of disease. Therapy with radionuclides is finding wider application as total medical knowledge is extended. The medical value of radioisotopes is apparent since over one million patients receive radioactive substances per year in the United States. It should be emphasized that wherever radioisotopes are available in hospitals for diagnosis and treatment the growing use is reflected on every service.

Radioisotope Laboratory Procedures. Microcurie doses of radioisotopes are given to patients in the clinical radioisotope laboratory for obtaining "tracer" measurements of various tissues or organs of the body. The rationale for using a specific radioisotope for a given study is based on the chemical and radiation properties. Chemically, the radioisotope must react exactly like the substance it is supposed to "trace." This affords selective concentration of certain elements in various tissues of the body. It is this feature which makes it possible to study the functions of tissues and to localize and differentiate tumors.

Clinical radioisotope diagnostic studies are generally grouped into the following categories: (1) function studies, (2) hematological studies, (3) body space studies, and (4) localization studies.

Function Studies. Function studies indicate the biophysical status of an organ or gland. Radioactive iodine is used to study thyroid function. The battery of thyroid tests is now well established and significantly aids in establishing diagnosis. There are ad-

ditional techniques which make it possible to study kidney, liver, cardiac and pancreatic funtioning.

Hematological Studies. Radioisotopes are playing an increasing role in the classification of anemias. A study known as the Schilling test uses radioactive cobalt tagged to vitamin B_{12} to determine whether a patient has a macrocytic anemia, such as pernicious anemia, or whether the intestinal tract is presenting with a malabsorption syndrome. In addition, there are other erythrokinetic studies, such as iron plasma clearance and iron utilization tests, which assist toward determining the presence and type of anemia.

One of the most commonly performed procedures is the blood volume determination. This dilution study detects the presence of internal or external blood loss. It serves as the most accurate index available for determining the proper volume for blood replacement. Physicians performing extensive surgery rely upon this quantitative information.

Body Space Studies. The total body water study is a radioisotopic method for determining the size of various physiologic body compartments and the rate of exchange between them. The treatment of cardio-renal disease, for example, is guided by the knowledge of water metabolism.

Another procedure in this group determines the status of electrolyte balance using radioactive sodium-24 and potassium-42. This determines the total amount of exchangeable sodium and potassium. Anyone who has been associated with the care of burn patients is aware that planning the proper therapeutic course is dependent upon this information.

Localization Studies. Detecting the presence of benign or malignant tumors may be accomplished with radioisotopes because the radioactive substance will selectively localize in certain tissues. It is the differential uptake of the radioisotope that makes it possible to locate brain, liver, bone or eye tumors. Another practical use is for studying the liver for metastases from other organs.

Therapeutic Uses

Therapeutic application of radionuclides can be used to inhibit the growth or extension of malignant disease and to reduce tumor size. Therapy may be administered by the following modalities: (1) biochemical placement, (2) physical placement, and (3) teletherapy.

Biochemical Placement. Biochemical placement is accomplished either by selective absorption or differential turnover.

Selective absorption requires that the diseased tissue take up a specific radioelement and localize it in sufficient concentration to inhibit or destroy the diseased area. For instance, the capacity of the thyroid gland to concentrate iodine from the blood stream and convert it into thyroxine makes it possible to administer a therapeutic dose of radioactive iodine to the thyroid gland.

Differential turnover is the rate of accumulation or turnover of a specific gland or organ, utilizing a given radioelement in the metabolic process of that tissue more rapidly than other surrounding tissues. Polycythemia vera is treated in this fashion with radioactive phosphorus-32 because the isotope is rapidly concentrated in the erythropoietic elements of the bone marrow. Chronic granulocytic leukemia is another disease where beneficial results have been obtained using radiophosphorus-32.

Physical Placement. Physical placement of radioactive substances may be used therapeutically in solid forms such as seeds, wires or needles. These may be inserted into body cavities, implanted interstitially, or topically placed for external application. A variety of sources, such as radium-226, radon-222, iridium-192 or cobalt-60, have been used for insertion or interstitial use. External applications of pure beta emitters, one example being the strontium-90 applicator, have been used to treat ophthalmic conditions such as pterygium.

Teletherapy. Teletherapy is external radiation. It is administered at a distance from a collimated gamma radiation source. The first radioactive substance used for this purpose was radium. In the past decade, the

availability of artificially produced radioisotopes in the supervoltage range, e.g., cobalt-60 and cesium-137, has increased significantly the value of this method of therapy. Treatment is administered by the radiotherapist who positions the patient at an appropriate distance from the selected radiation source for the period of time calculated to deliver the prescribed therapeutic dose.

Other Nuclear Age Frontiers

Nuclear Propulsion Programs. The Navy's nuclear propulsion program for submarines and surface ships represents a new frontier in maritime transportation. Progress has been possible because of the successful missions of "Nautilus," "Seawolf," "Triton" and others. Considerable information and practical experience has been gained in environmental medicine particularly with regard to radiation exposure. As a result, maximum safety measures prevail and there is minimum exposure of personnel to radiation hazards. All precautions, however, do not preclude the possibility of a radiation accident. Recognition of this potential creates a priority requirement for adequate numbers of trained medical and nursing personnel to cope with radiation problems.

Reactor Research. Reactor research is conducted during peacetime to promote a better understanding of the body in health and disease. The power of these reactors ranges from a few watts to megawatts. Studies of the biologic effects of radiant energy are continuing so that basic knowledge in the field of radiobiology may afford investigation of the potentialities of radioactivity both as a therapeutic agent or a health hazard. The ever present possibility of accidental radiation exposure could result if power control of a reactor excursion could not be maintained.

Military and National Defense Programs. All branches of the Armed Forces are engaged in weapons development programs to investigate thermonuclear weapons potential. Nuclear weapons consisting of fissionable materials are stored in many areas, and are necessarily transported from one site to another. Transportation and handling of these weapons can be hazardous and the possibility of accident cannot be totally eliminated.

Navy Medical Nuclear Education Programs

In 1948, when the Navy's first clinical radioisotope laboratory was established, the mission was to provide patient care and to promote education and clinical research. Increased nuclear energy applications made it evident that an urgent need existed for more trained personnel in this field. Limited training facilities in this area indicated a distinct requirement for establishing medical nuclear training programs for medical and paramedical personnel. The first of these courses was conducted at the U. S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland, in 1950.

Continued medical progress in the use of radioisotopes and servicewide developments in nuclear energy made specialized preparation mandatory for nurses. Consequently, a "Nuclear Nursing" course convened at the Naval Medical School in September 1958. Presented at the university level, this four-month program was structured to meet the impact technological advances had placed on nursing practice.

THE NUCLEAR NURSING CURRICULUM

Aim

To gain knowledge and understanding of the scientific principles underlying radioisotope and disaster management procedures as they relate to medical diagnosis, treatment and nursing care of patients.

Curriculum Hours

Basic science portion—8 weeks

	Lecture	Laboratory
Mathematics	48	
Statistics	5	
Physics	10	
Radiation Safety	24	34
Nuclear Physics	24	39
Biochemistry	44	40
Radiobiology	10	
Total Hours	167	113

Curriculum Hours

Clinical laboratory period—8 weeks

	Lecture	Laboratory*
Clinical Radioisotope Theory	112	89
Nursing Seminars	8	
Critiques	2	
Disaster Management Procedures	44	10
Total Hours	266	99

Grand total:
Lecture hours 333
Laboratory hours 212

* Field Trips pertinent to the applicable course subject are credited to laboratory hours.

The curriculum hours devoted to the basic science portion may appear formidable. Comprehensive presentation of these subjects has been predicated on the belief that a firm working knowledge of basic mathematics and fundamentals of basic sciences is necessary. This is done to produce individuals who can form a nucleus of well-trained and knowledgeable nurses capable of intelligently contributing to the education of others, and to constructively add to the continued improvement of patient care.

The second segment of the course is devoted to lectures on clinical radioisotope laboratory procedures and therapeutic uses of radioisotopes. Physicians qualified in nuclear medicine and guest lecturers representing a wide range of professional experience greatly add to the total quality of the program. Clinical laboratory experience is provided so that theory and practice may be closely interwoven. Seminars are held to evaluate and investigate methods for improving nursing care procedures. Critiques are planned to discuss the total teaching effort with the idea of using this information in revising and planning future courses. One week of intensive training in disaster management is given. Field exercises are held to reinforce the formal teaching, since it is recognized that during radiation disaster realistic evaluation and treatment of casualties will necessarily become the nurse's role.

In Naval hospitals, as well as other military and civilian institutions, the multiple medical uses of radionuclides predicate a need for more nurses to acquire specific knowledge and skill in nuclear nursing techniques and radiological safety practices associated with the care of patients receiving radioactive substances. The "Nuclear Nursing Orientation Course" offered in April 1960 was an effort to reach registered professional nurses associated with the direct nursing care of radiation patients. This was a concentrated two-week program. Short courses of this nature will, in my opinion, help to bridge an existing gap which stems from insufficient basic science content on all educational levels. In the face of inescapable reality, there is a valid and pressing need to take action for maintaining nursing proficiency. Concerted action within the profession will help to focus on methods for reducing certain deficiencies. Some factors for consideration might be to look at current trends that exert an influence on nursing, and to probe into known areas of weakness to obtain better definition of the problem at hand. This kind of investigation helps to point up new goals for improving the art and science of nursing. Utilizing educational resources and devising appropriate methods for sharing special facilities will allow wider distribution of knowledge. Military nursing programs have been an outstanding example of cooperative effort to achieve mutual benefit.

Twentieth century nursing careers involve competent fulfillment of responsibilities and capable health team membership. Understanding of clinical radioisotope studies and therapeutic procedures will be required in whatever capacity or medical area the nurse may serve. Nursing care of the radiation patient, whether therapeutically or accidentally exposed to radiation, is a matter of extending nursing functions. The nurse's knowledge and experience, plus the application of radiological health safety precautions and nuclear nursing techniques tailored to the specific needs of the individual patient, accomplishes the objective.

Radioisotopes are drugs—radioactive drugs. Nurses assisting with radioisotope procedures, as with any other medical procedures or drug administration, are obliged to have complete knowledge of the pharmacology involved. This brings us to the question of essentially what information would the nurse require to have a general understanding of radioactivity and the medical applications of radioisotopes. I should like to submit the following subjects as basic preparation: (1) properties of radiation, (2) units of radiation, (3) interaction of radiation and matter, (4) radiological procedures for detection and measurement of radiation, (5) personnel protection principles, (6) decontamination methods, and (7) orientation to diagnostic and therapeutic radioisotope procedures. This knowledge of radiation safety protection, detection, and control prepares the nurse for understanding of the unique planning required for the care of radiation patients, rudimentary knowledge of the biological effects of radiation, basic understanding of the biological effects of ionizing radiation, and competent use of radiation monitoring instruments.

Areas of Nursing Function

The capability of nurses' functioning in any area of the hospital environment is enhanced by the additional knowledge of nuclear nursing. A summary of how this knowledge complements the quality of patient care is given.

Chief of Nursing Service. As the nursing representative serving on hospital committees she must have specific understanding of problems unique to the situation when helping to establish policies concerned with current medical concepts. This understanding promotes group unity and action, and helps to coordinate nursing activities with the over-all hospital program. Nursing leadership also demands her participation in revising and developing nursing techniques for the improvement of patient care.

Division Supervisor. Serving in a supervisory capacity, the nurse must possess the ability to make good decisions whenever problems arise. She is in a better position to objectively evaluate situations and plan according to need. Knowing fundamental radiological health safety principles helps in planning staff rotation to achieve minimum radiation exposure and maximum utilization of personnel.

Charge Nurse. The individual associated with direct nursing care has an exacting function to perform. Technical competence in this capacity helps to improve communications. Patients receive clear explanations, co-workers are given concise and correct instructions, safety of the patient, his visitors, and the whole health team is assured, and the physician is more skillfully assisted with special procedures.

Nurse Educator. The nurse charged with teaching others advances learning by stimulating staff personnel to expand their knowledge. Promoting education by presenting well-organized in-service programs necessitates continuous revision of teaching materials so that information concerning current concepts is given. The qualified instructor systematically improves her own knowledge and ability when striving to improve the preparation of others.

Clinical Radioisotope Laboratory Nurse. In the laboratory, the nurse assists the physician with diagnostic and therapeutic radioisotope procedures. She serves in a liaison capacity to the clinical units. An important facet of her work is the health teaching of patients and their families and reinforcing the physician's therapeutic regime. Another function is participating in the development of nursing care procedures designed for improving nursing management of radiation patients. Finally, an interesting part of her duties is collecting research data.

Summary

In visualizing the broad horizons brought about by scientific advances in the nuclear age, the nursing profession is challenged to keep pace. The complexity of technological changes dictates the need for concerted ac-

tion for truly preparing nurses to assume expanding professional roles and increasing responsibilities. Achieving this goal is a matter of revising concepts and recasting educational philosophy in terms of present and future needs.

Today, the need for advanced education is acknowledged by those who desire to dedicate their efforts toward skillful participation in the specialized discipline of a new and challenging era. General Sarnoff, president of the Radio Corporation of America once said, "To meet the challenge of the future our imagination must be bold, but it must be balanced by wisdom based on knowledge."

BIBLIOGRAPHY

[1] Blahd, W. H., Bauer, F. K. and Cassen, B.: *The Practice of Nuclear Medicine.* Charles C Thomas, Springfield, Illinois, 1958.

[2] *Bulletin of the Atomic Scientists,* 14:1, 1-64, January 1959.

[3] *Radioisotopes in Science and Industry.* Atomic Energy Commission Special Report, January 1960.

[4] Hahn, P. F.: *Therapeutic Uses of Artificial Radioisotopes.* Wiley and Sons, New York, 1956.

[5] King, E. R.: The Management of Victims of Radiation Accident. *Southern Med. J.,* 52:4, 432-440, April 1960.

[6] *Laboratory Guide to Nuclear Medicine.* U. S. Naval Medical School, Bethesda, Maryland, 1959.

[7] Quimby, E. H., Feitelberg, S. and Silver, S.: *Radioactive Isotopes in Clinical Practice.* Lea and Febiger, Philadelphia, Pa., 1958.

[8] *Wisdom,* Vol. 22, p. 70 (1959).

"We've gotten so used to talking about disease that we've forgotten about health. That's true of doctors, too. They've got so much new knowledge about diseases that prevention is rather neglected," says Dr. Paul Dudley White. . . . "Machines should be our slaves and not our masters. Muscles should be used. We've changed from the vigorous muscular people we once were into an over-nourished, too-prosperous people. There's too much rich food, too much television, too many automobiles. We've gotten off the track. But it's not too late to mend."—ARTHUR HERZOG, *Think,* International Business Machines Corp.

Case for Diagnosis

A 60-YEAR OLD white male experienced abrupt onset of total gross hematuria and left flank pain. A mass was palpable in the left flank. Intravenous pyelogram revealed no function on the left. Left retrograde pyelogram is shown.

AFIP Neg. No. 54-1369
Operation: Left nephrectomy.

From the Armed Forces Institute of Pathology, Medical Illustration Service, Colonel Frank M. Townsend, USAF, MC, The Director. This case is AFIP Accession 639947, contributed by Fitzsimons General Hospital.

Diagnosis is given on page 724.

EDITORIALS

Our Annual Meeting

OUR 68th Annual Meeting takes on an international tone this year with its theme: "International Medicine—Path to World Progress."

Dr. Leroy E. Burney, former Surgeon General of the U. S. Public Health Service, has not only an interest in world health problems but has been an important figure in the World Health Organization. His new position as Vice President of Health Sciences at Temple University, Philadelphia, gives him ample opportunity to extend his interest in health problems of other nations and to create an interest of the younger generation of medical, dental, nursing, and allied medical people to the health conditions of other countries.

Nations must develop themselves in health matters as well as in other matters pertaining to their countries. America can help by understanding some of these problems. In this annual meeting we are attempting to extend this understanding.

The ladies will not be left out. The luncheon on Tuesday, November 7, will be the highlight of their events. Watch for the September newsletter to members and reservation form for those events.

Now let's meet in Washington for this annual affair which this year is on November 6, 7, and 8. Pre-registration on the afternoon of November 5, of course. There is no registration fee, you know, and everyone is invited.

Our Responsibility

NOW that we are facing another crisis in our country it is necessary that we take some sort of an inventory of ourselves to determine our potential should disaster strike our area, possibly even our homes.

Just how much do we know about first aid? Do we have some medical supplies on hand? Do we have some non-perishable food on hand to carry us over at least two weeks? What about a water supply—this being a very essential item for survival. Then there is the matter of blankets and some sort of fuel, certainly of a slow combustible type. Have we thought of a place for shelter where all these things can be stored?

Then again are we preparing ourselves psychologically so we do not contribute to the mass hysteria so prevalent at first in a disaster? Are we going to be able to help or are we going to be one of those who will hinder?

Now let us prepare ourselves, our homes, our communities for these ever increasing emergencies that are facing our country. Some will survive, of course, if nothing is done. More will survive depending on our state of preparedness. It is the responsibility of each of us to prepare himself and not look to the government to do it for us. Too much dependence has been placed on others when we can, if we will, solve our own problems.

The Association of Military Surgeons of the United States

Founded 1891, Incorporated by Act of Congress 1903

Suite 718, New Medical Bldg., 1726 Eye Street, N.W., Washington 6, D.C.

Telephone NAtional 8-2206

Official Journal: MILITARY MEDICINE

EXECUTIVE COUNCIL—1961

BOARD OF TRUSTEES, RETIREMENT FUND

LIVING PAST PRESIDENTS

(Rank held at time of office)

SUSTAINING MEMBERS

It is a privilege to list the firms who have joined The Association of Military Surgeons as Sustaining Members. We gratefully acknowledge their support.

ABBOTT LABORATORIES
AMERICAN STERILIZER COMPANY
AMES COMPANY, INC.
ASTRA PHARMACEUTICAL PRODUCTS, INC.
AYERST LABORATORIES
BAXTER LABORATORIES, INC.
BECTON, DICKINSON AND COMPANY
BURROUGHS WELLCOME & CO. (U.S.A.) INC.
CIBA PHARMACEUTICAL PRODUCTS, INC.
COOK-WAITE LABORATORIES, INC.
CUTTER LABORATORIES
EATON LABORATORIES, DIVISION OF THE NORWICH PHARMACAL CO.
GENERAL ELECTRIC COMPANY
HOFFMANN-LA ROCHE, INC.
LEDERLE LABORATORIES DIVISION, AMERICAN CYANAMID CO.
LILLY, ELI, AND COMPANY
MALLINCKRODT CHEMICAL WORKS
McNEIL LABORATORIES, INC.
MEAD JOHNSON & COMPANY
MERCK SHARP & DOHME
ORTHOPEDIC EQUIPMENT COMPANY
PARKE, DAVIS & COMPANY
PFIZER, CHAS. & CO., INC.
PICKER X-RAY CORPORATION
RITTER COMPANY, INC.
ROBINS, A. H., COMPANY, INC.
SCHERER, R. P., CORPORATION
SCHERING CORPORATION
SEARLE, G. D., & CO.
SMITH KLINE & FRENCH LABORATORIES
SQUIBB, E. R. & SONS, DIVISION OF OLIN MATHIESON CHEMICAL CORP.
STEPHENSON CORPORATION
UPJOHN COMPANY, THE
WARNER-CHILCOTT LABORATORIES
WINTHROP LABORATORIES, INC.
WYETH LABORATORIES

Around the World

(Ser. IV, No. 9)

By
CLAUDIUS F. MAYER, M.D.

ITALY is celebrating the first centenary of her national unity this year. The festivities opened in Turin on May 6, and they will conclude 31 October. Turin was selected because the chief city of the Piedmont played an important role in the Italian *Risorgimento.* The Italian government has approved funds of over 10 billion lire for the celebrations and for repairs to some of the most important historical monuments in Piedmont. The program was arranged so that it gives a complete and balanced picture of the economic progress which Italy has made since 1861. Of particular importance are three exhibitions: the Historical Panorama, the International Labor Exhibition and the Exhibition of the Regions of Italy. Of special interest to physicians and sociologists is the *International Labor Exhibition* whose topic is "Mankind at Work." It is divided into a strictly Italian section, showing "a century of technological and social conquest," and a strictly scientific section in which foreign countries are also represented. Czechoslovakia shows the cooperative movement in agriculture. Denmark exhibits the housing problem. Finland throws light upon recreation and cultural pastimes. West Germany points out vocational training and assistance. Japan participates with a show of the shipping industry and sea-faring activities. Great Britain emphasizes scientific research, while Jugoslavia selects the status of labor relations. Poland's topic is the social security, while Switzerland's subject is the natural surroundings and the worker.

Among the many scientific and medical congresses which were held this year in Italy one of the most interesting was the *International Congress of Medical Genetics* in Rome. This congress was held at the Gregorio Mendel Institute (founded in 1953) under the guidance of Luigi Gedda, Director of this Institute and professor of human genetics at the University of Rome. This congress, with the participation of the geneticists of many countries, demonstrated the great progress which this relatively new science has made during the past few decades. It also pointed out the great importance of genetics in the prevention and treatment of the hereditary diseases of man.

An Italian doctor who made himself known at the fifth International Congress of Gerontology and Geriatrics, held in San Francisco just a year ago, suggested a unique plan for the establishment of an *International Center of Rejuvenation,* a pilot center which would be open to students and practitioners and where the various problems of aging could be studied, with the ultimate aim to find *biological methods* for the retardation of old age. Rejuvenation itself—says Dr. Fraschini, the planner—is nothing but an utopia, but "re-invigoration" is a reality. In the geriatric studies, much could be learned from the kingdom of the plants. Many species of plants have very long lives, and they seem to be immune to malignant tumors. It would be possible, perhaps, to detect the hormone-like substances, and extract them from the plants for the benefit of mankind. There are nowadays two great problems which the whole world is facing—famine and aging. Both require an international approach for their study and for their relief.

The progress of modern medicine in Italy can be illustrated perhaps by two small items better than by any elaborate treatise. One is the fact that *malaria in Sardinia has been completely exterminated.* The public health officer of the Province of Sassari re-

ported that during 1960 there was no trace of the disease, neither a new case, nor a recurrence. The other small item throws light upon the up-to-date status of the *pharmaceutic industry in Italy*. In 1960, more than a thousand smaller and larger pharmaceutical houses existed in the country which together could produce any medicament now needed and used in medical practice, including the special remedies. At present, the Italian commerce is able to supply 14,500 listed medical specialties or proprietary medicines; the overwhelming majority of them are Italian products. In 1959, according to unofficial statistics, Italy spent almost 21 billion lire on imported drugs, but received over 18 billion lire for the medicaments exported from the country.

Street traffic accidents are on the increase in many countries. The French authorities published statistics related to the automobile accidents in 1960. There were 67,787 accidents in which 96,889 were injured, and 5,804 died. These figures are larger than in the previous year. The major causes of accidents were grouped under the following categories: non-observance of the other driver's priority right (10,665 cases); excessive speed (8,963); driving on the wrong side (7,333); lack of attention (7,387); imprudence of pedestrians (6,461); incorrect passing, or lack of visibility (3,880); inebriety (2,354). The most fatal are the summer months, the Sundays and holidays, and the hours of the day between 18 and 21 o'clock (6-9 P.M.).

In *Canada*, the business of the so-called *itinerant surgeons* is blooming. This reminds us of the times of past centuries when dentists and surgeons travelled from village to village, and at the market place they set up their headquarters, exhibited their various diplomas and recommending letters, and were ready to then practise in the open. The Canadian itinerant surgery is, however, defined by the *Royal College of Physicians and Surgeons of Canada* as follows: "surgery performed on a patient unfamiliar to the surgeon at a distance from his practice and where the diagnosis and preoperative and postoperative care are delegated to another physician." The College recognizes that the operative procedure is only a portion of the surgical care of the patient, and holds that, as defined above, the itinerant surgery is detrimental to the best interests of the patient and contradictory to the present concepts of comprehensive surgical care. When the circumstances would require that an operative procedure be carried out by a surgeon in a hospital remote from the site of his regular practice, then he must be responsible for the diagnosis, preoperative and postoperative care. It is unethical to divide the regular surgical fee between the participating surgeon and the practitioner, declares the Council of this Canadian medical association.

At the Fourteenth General Assembly of the World Health Organization, held this year at New Delhi, a Cuban doctor described the *progress of health in Cuba,* with the intention to prove that the Cuban people are now better taken care of than under the previous administrations. In 1958 the budget allocations for health amounted to 21 million dollars; in 1961, they were raised to 71 million, which would be a 228% rise, or, practically speaking, the government is now spending \$11.66 for each of the 6½ million Cuban inhabitants. If it is true, this would be almost the highest per-capita expenditure on public health in the Latin American countries. With so much additional money, the number of hospital beds could be raised from the pre-revolutionary 11,411 to 20,501 at the start of this year. The plans for 1961-1962 foresee an additional increase of 3,000 beds, most of them provided in the rural and suburban areas. The number of the doctors is also growing (?). At the time of the "fall of the tyranny," 749 physicians were practicing in Cuba; now, there are 3,125 (but where did they come from?). Their salaries were doubled. The number of the nurses was also almost tripled, a total of 2,391, while the technicians at the various posts number 1,262. Cuba is still a member of the

Pan American Sanitary Bureau and of the WHO, and as such it is getting its share from the various international health programs, such as malaria eradication program, eradication of the yellow-fever mosquito, integrated health program, fellowship awards in various public-health schools in Latin America. Technicians of the Pan American Sanitary Bureau are working as consultants in Cuba. The preventive medical services have been also strengthened; thus, more than half a million children were inoculated with the B.C.G. vaccine partly intradermally, partly orally, and the smallpox vaccinations are also maintained. For the past 10 years, Cuba has not had a smallpox case. A *Rural Medico-Social Service* was started with over 500 physicians and nurses, and with 50 rural hospitals where the peasants receive medical care and drugs completely gratis.

A recent publication of the Hebrew University of Jerusalem is a sort of intellectual inventory, showing what the *medical and biological research* accomplished in the *State of Israel* since its foundation in 1948. Palestine was always a "desolate land" and a battlefield of small tribes since the times of the Old Testament. It is a new role which the country assumes as an active, fervent center of scientific research. The rapid progress was made possible by such institutions as the Hebrew University of Jerusalem, the Hadassah Organization, the Weismann Institute of Science, and the Institutes of Biological Research and of Agriculture. The activities are coordinated by the Ministries of Health and of Agriculture, and as a result of such coordination the desolate land is blooming again, with prospects of cultivation even in the desert. Israel's population of only 2 million has about 5,000 physicians (1:400).

In India, a religious or spiritual organization is in existence, called the *Order of Râmakrishna* whose members are sort of buddhist monks, devoting their lives to meditation, education in schools and colleges, and service in the hospitals. The Order had about 83 centers at the end of 1957, scattered in such countries as West Bengal, Uttar Pradesh, Madras, Bihar, Assam, Bombay, East Pakistan, Burma, Ceylon, even in England and in the U.S.A. It also served 13 hospitals, and 67 outdoor dispensaries which treated almost 3 million patients in that year. The monks also worked in the Veterinary Section of the Shamala Tal Ashrama where they took care of 2,272 animals. They also function at times of disasters in the same way as the Red Cross does, giving relief work in times of famine, flood, cyclone and tornado, earthquake, riots, etc.

The *Indian Council of Medical Research* is greatly interested in the apparent increase of death from *heart failure*. After four years' study, the conclusion was made that the chief contributory factors are sedentary occupations, obesity and a fat-rich diet. Another factor which comes to light from the Council's studies is the possible role of large-scale infection caused by *viral agents of heart diseases*. The epidemics of infectious hepatitis are more and more prevalent in towns (e.g., Delhi) and larger cities. Some recent heart failures were seen among comparatively young people. The critical age for the heart attacks is between 40 and 50. It is possible that the infectious hepatitis causes a temporary damage to the heart muscle, and this increases a person's susceptibility to heart diseases. Surveys made at Delhi and at Agra indicate that heart failure is largely an urban affliction, and that the male sex predominates among the sick.

This note from India about the possible myocardial damage caused by hepatitis virus seems to be corroborated by other reports on *viral myocarditis* which are now more and more abundant in all parts of the world (U.S.A., Czechoslovakia, England, etc.). Such heart disease may occur in mumps, measles, poliomyelitis, varicella, smallpox, yellow fever, psittacosis, mononucleosis, epidemic hemorrhagic fever, etc. Especially the Coxsackie B virus group is blamed for many recent cases of viral myocarditis in newborn babies (latest report from the Belfast Virus

Reference Laboratory). Some of these cases are fatal; others may fully recover (the majority of cases). Myocarditis also occurs in some cases of viral influenza, especially the Asiatic type.

As to *epidemic hepatitis,* it now constitutes an important problem in the majority of countries. We may recall that in the U.S.A., in the first seven weeks of this year more than 11,000 cases occurred. The disease has been known in Central Europe for several centuries, but its infectious character was recognized only after, or at the time of, the First World War. Studies on the etiology and pathology of epidemic hepatitis are especially intensive and well organized in the so-called Iron-Curtain countries. Although the virological studies were not fully successful, most of the investigators are firmly convinced that there must be several varieties of the virus of epidemic hepatitis present in Nature as the virus is exposed to different environmental conditions and changes its behavior locally or countrywise. Pathological studies also proved that in epidemic hepatitis we are dealing not with a liver ailment only but with a general infection which may affect also the central nervous system and the other organs (heart, kidney) of the body. Absolutely sure diagnostic tests for infectious hepatitis are, as yet, not available.

In the majority of the European countries, epidemic hepatitis has become one of the reportable infectious diseases (since 1947). In Bulgaria the morbidity rate of the disease is 162 per M (100,000 inhabitants), while in Hungary it is 177 per M. But the largest morbidity rate is produced in Czechoslovakia (316 per M in 1955) where the detection of the disease and its epidemiological control are the best organized. Until recently it was held that the unique source of infection in epidemic hepatitis is man (the sick, the anicteric sick and the virus carrier); lately some scholars from Moskva suggested that *animals also may serve as reservoirs* and sources of this infection (notably dogs, sheep, and horse). It is also believed that patients who recovered from their sickness remain excretors of the virus (mostly in bile and feces) for many years. But the most frequent pathway of the infection seems to be the digestive tract, so that actually the disease is a type of intestinal infection, although the virus also can be transmitted by blood transfusions, or parenterally by syringes which are not properly sterilized. Here is the chief *danger of homologous immune sera* against measles, or pertussis. For the avoidance of "inoculation jaundice" in military collectives, parenteral treatments in Army units are said to be reduced to the minimum in the military services of the Communist countries.

The *status of surgery* in the countries of *Communist Asia* has considerably changed in recent years. The communists themselves ascribe the wholesome change to the fact that the health protection of the people is now a State problem. The State gives material support and moral aid to the medical personnel and to the medical institutions, so that clinical and research activities can be conducted in all branches of medicine and surgery. *In Red China,* the surgical clinics of Shanghai, Peking, Nanking, Hanciu, Uhan and others, claim to have achieved fame by their successful practice of thoracic surgery. The statistics of these clinics sometimes run into thousands of radical and palliative surgical treatment of pulmonary tuberculosis and bronchiectasis. Chinese surgeons claim anastomotic suture of the bronchi, an operation which is still in the experimental stage in the western countries. Chinese surgeons claim to excel in the very difficult cardiac surgery; thus, at Shanghai, mitral stenosis was surgically treated since 1957. Chinese surgeons claim operations for coronary thrombosis, or for atrio-atrial septal defects. They are also acquainted with anesthesia by artificial hibernation. The *preponderance of schistosomosis in China* gives ample opportunity for the practice of porta-caval and spleno-renal venovenous anastomoses for the surgical treatment of the sequelae of the disease.

Korean surgeons in North Korea had a

chance to advance military field surgery. During the war years (1950-1952) they had an opportunity also to mobilize the sanitary service all over North Korea, and to develop field surgery as a science. Naturally, Soviet surgeons were the instructors who taught the re-employment of medical and surgical material captured in the war; how to make sterilizers from destroyed tanks of the enemy, or how to prepare surgical suture from salvaged parachute material. Korean surgeons also learned the primary management of gunshot wounds, the therapeutic principles of shock treatment, the way to organize blood-transfusion posts, how to treat osteomyelitis, and the burns resulting from napalm bombs. All these facts are apt to corroborate the old observation that the best stimulus of medical advancement is found on the battlefields.

Recent statistics, which are essentially incomplete for various reasons, indicate that at present there are over two million *registered leprosy cases* in an estimated world population of two billion. The chief distribution of lepers is: Africa (1,426,000 cases), India (270,000), South East Asia (132,700), and South America (123,500 cases). A little less than 10% of these patients reside in leprosaria; the rest are outpatients, or work in agricultural colonies. There is a growing serious barrier between the disabled leper and the surgeon, due to the lack of centers for hospitalization. This is a major problem in the treatment of leprosy by physical medicine. Such statistics are, of course, incomplete by their very nature. Moreover, nobody knows for certain the exact count for the *population of the world*. According to a late forecast by the Department of Economic and Social Affairs of the U.N., by the end of 1961 the world population will reach three billion, and the present annual increase is 50 million, which is about the size of the population of Italy.

At a recent meeting of the Scientific Publication Council (Great Britain) the question came up about how far *an editor* should go in correcting an author's manuscript. One of the participants (K. D. Keynes) said that, while in matters of taste the author should always have the last word, the editor should *insist on clarity* and should ensure the accuracy of any data that are published. Editorial interference may be objectionable but editorial neglect is worse, as it can be seen, for instance, in a number of textbooks and symposium volumes that may bear the names of eminent scientists as editors, but in which the so-called editors have not actually done any coordinative editing at all. Another medical authority (A. S. Parkes) suggested that all papers should leave a scientific department in a shape ready for publication. On the other hand, since some manuscripts written by scientists are very poor as products of literature, nobody can expect that a department head could replace the experienced editor in the highly skilled task of revising for publication. An editor often needs to be a diplomat. He must know how to effect a useful compromise without causing resentment.

On the other hand, as an American participant of the meeting asserted (T. H. Osgood), an editor who did his job well must expect to make one or two enemies every year, unless his letters of rejection would take the following form occasionally: "Dear Sir, Although your paper fills a much-needed gap in the literature, I regret that it cannot be accepted for publication"... *Multa paucis!*

NOTES

Timely items of general interest are accepted for these columns. Deadline is 1st of month preceding month of issue.

Department of Defense

Deputy Ass't Sec'y of Defense (Health and Medical), Off. Ass't Sec'y of Defense for Manpower—FRANK B. BERRY, M.D.

PERSONNEL CHANGE

Dr. Frank B. Berry has been appointed Deputy Assistant Secretary of Defense (Health and Medical), Office of Assistant Secretary of Defense, Manpower, as of August 1.

Dr. Edward H. Cushing who held the position has resigned.

APPOINTMENT

Dr. Gustave J. Dammin, Chairman of the Armed Forces Epidemiological Board, has been appointed the first Elsie T. Friedman Professor of Pathology at Harvard. Announcement was recently made by Dr. George P. Berry, Dean of the Faculty of Medicine.

GUSTAVE J. DAMMIN, M.D.

Dr. Dammin has been a member of the Faculty of Medicine and Pathologist-in-Chief at the Peter Bent Brigham Hospital since 1953.

The Friedman Professorship was recently established at the Harvard Medical School on the basis of a gift to the university from the trustees of the Elsie T. Friedman Charitable Foundation of Boston.

At the Peter Bent Brigham Hospital, Dr. Dammin will serve as director of a Cardiovascular-Renal and Transplantation Center soon to be established with the help of a half-million dollar grant from the National Institutes of Health. A grant has also been given for the purchase of an electron microscope for use in tissue studies.

During World War II, Dr. Dammin was executive officer and parasitologist with the Dysentery Commission in the India-Burma Theatre.

AT AMA MEETING

The Military Section of the American Medical Association held an interesting two day meeting in New York in June.

One of the important papers was that of Mr. C. Frank Consalzio of the Army Medical Research and Nutrition Laboratory at Denver. He pointed out that the food requirements of men exposed to solar radiation and heat such as we find in the tropics are not lessened as formerly thought but are actually increased. Furthermore, there is no need to change the items in the ration.

Mr. Consolazio and his associate, Ralph Shapiro, of Rutgers University state that the current recommendations of the National Research Council and the UN's Food

U. S. Army Photo

AT AMA MEETING, NEW YORK

(L. to R.): Maj. Perry B. Miller, USAF, MC, Brooks AFB; Col. Chas. Moseley, MC, USA, Exec. Sec'y., AFEB; Lt. Chas. Moseley, Jr., MC, USN, U. S. Naval Hosp., Portsmouth, Va.

and Agriculture Organization for decreased food allowances for men living in hot environments should be reevaluated.

In the exhibits area at the meeting were several from the Armed Forces. The one shown here is that of the Armed Forces Epidemiological Board.

HEKTOEN BRONZE MEDAL RECIPIENTS

Colonel Joe M. Blumberg, MC, USA, Deputy Director; S. I. Zacks, M.D., and Captain Walter C. Bauer, MC, USA, all of the Armed Forces Institute of Pathology, were presented with the Hektoen Bronze Medal of the American Medical Association for their exhibit on "The Myasthenic Neuromuscular Junction" at its recent meeting in New York.

MEDICARE DIRECTOR PROMOTED

Brig. General W. D. Graham, MC, U. S. Army was recently elevated to that rank. He is Executive Director of the Office for Dependents' Medical Care. He has been on active duty with the Army Medical Service since 1934.

AFIP PHYSICIAN QUALIFIES

Major Pierre A. Finck, MC, on duty at the Armed Forces Institute of Pathology has been notified by The American Board of Pathology that he has demonstrated his proficiency in the special field of forensic pathology.

SHIPMENTS TO AFIP

More care should be taken in shipping pathologic material to the Armed Forces Institute of Pathology, Washington. Tissue specimens, though packaged in plastic bags, should not be placed in containers along with microslides and paraffin blocks, as sharp corners can puncture the plastic, causing leaking of fluids that damages shipment.

Slides should be well padded, regardless of the type of container used. All blocks pertaining to a single surgical or autopsy case should be placed in one box; these small boxes should then be grouped in one large container.

Case histories should not be placed inside of boxes containing pathologic materials, unless they are placed in plastic bags for protection. Sturdy boxes should be used for shipment.

PG COURSE

Introduction to Research Methods is the title of a short postgraduate course which will be given at the Armed Forces Institute of Pathology, Washington, October 23-27. The course is designed to provide investigators with basic instruction and source of further information on selecting, planning and carrying out research problems, including use of medical literature; laboratory animals; data collection, analysis and presentation, medical writing and illustration; and support of research.

Further information can be obtained by writing to the Director of the Institute, Washington 25, D.C.

Army

Surgeon General—Lt. Gen. LEONARD D. HEATON

Deputy Surg. Gen.—MAJ. GEN. THOMAS J. HARTFORD

PROMOTED

Major General Floyd L. Wergeland, Commander of the Walter Reed General

Hospital, was recently promoted to that rank. Officiating at the promotion was Lt. General Leonard D. Heaton, The Surgeon General of the Army. The Commanding General of Walter Reed Army Medical Center, Major General Clinton S. Lyter, Dr. Frank B. Berry, Department of Defense, and Dr. Janet Travell, White House physician, were present at the ceremony.

HEADS ADVISORY COUNCIL

Brigadier General Frank E. Wilson, a vice president of the Association of Military Surgeons of the United States, has been designated as chairman of the Surgeon General's Advisory Council on Reserve Affairs by Lt. General Leonard D. Heaton, The Surgeon General of the Army.

The Council is composed of all Ready Reserve General Officers of the Army Medical Service and advises General Heaton and his staff on such matters as annual active duty for training (ANA CDUTRA), educational requirements and standards, and mobilization capabilities for medical reservists.

General Wilson commands the 805th Hospital Center to which is attached 13 TO&E hospitals and medical detachments throughout the XXI Corps. His civilian occupation is Executive Vice President of the Joint Blood Council in Washington, D.C.

ASSIGNMENTS SGO

Recent assignments of the Office of the Surgeon General are: Colonel William C. Burry, MC, to Directorate of Personnel and Training as Deputy Director for Personnel and Chief of the Military Personnel Division. He succeeds Colonel Francis W. Regnier.

Colonel Adam J. Rapalski, MC, as Chief of the Preventive Medicine Division in the Directorate of Professional Service. Previous assignment was that of Commanding Officer of the U. S. Army Environmental Hygiene Agency, Army Chemical Center.

Lt. Colonel Roswell G. Daniels, MC, as Chief of the Occupational Health Branch, Preventive Medicine Division.

Lt. Colonel Donald H. Glew, Jr., MC, as Chief of the Surgical Research Branch, U. S. Army Medical Research and Development Command. He is co-author with Lt. General Leonard D. Heaton, The Surgeon General, of the chapter on "Penetrating Wounds of the Abdomen" in *Abdominal Surgery* (Paul B. Hoeber, Inc.).

Lt. Colonel William T. Leslie, MC, as assistant chief of the Physical Standards Division in the Directorate of Professional Service.

Lt. Colonel Russell W. Sumnicht, DC, to the new Preventive Dentistry Branch as its Chief. He will be responsible for organization of this new branch developing programs.

Captain Joseph P. Jacobs, MSC, as Assistant for Combat Development, Directorate of Plans, Supply and Operations.

Captain David W. Marble, MSC, as Civil Engineer, Installations Branch, Plans Division, Directorate of Plans, Supply and Operations. He holds a B.S. in Civil Engineering and M.S. in Sanitary Engineering.

AT BROOKE ARMY MEDICAL CENTER

Brig. General Clarence P. Canby has become the new Director of Dental Activities. This was recently announced by the Center Commander, Major General John F. Bohlender. General Canby succeeds Brig. General Henry R. Sydenham who recently retired.

Colonel Glenn J. Collins has been named Assistant Commandant of the Medical Field Service School.

Colonel Peter Zanca, Chief of Radiology at Brooke General Hospital, has been elected president of the San Antonio Radiology Society. This society meets monthly at Fort Sam Houston.

Lt. Colonel Allen F. Kingman, Jr., has returned to Brooke Army Medical Center and has again become Chief of the Neurosurgery Service at Brooke General Hospital.

The appointment late in June of Colonel Glenn J. Collins, Assistant Commandant, brings to three the number of full profes-

sors of hospital administration at the Medical Field Service School who are listed on the staff of the Graduate School of Baylor University.

Other professors are Colonel Glenn K. Smith and Lt. Colonel Howard B. Scroggs, Director and Deputy Director of the Department of Administration.

One officer, Lt. Colonel Dan G. Kadrovach, Chief of the Command Management Branch, holds the position of Associate Professor. Instructors who are Assistant Professors are Lt. Colonels Walter F. Robbins, George F. Conrad, James M. Horner; Majors Paul I. Kaufman, Forest L. Neal, and Mrs. Rose T. Nigrelli.

VETERINARIAN OF FIRST ARMY

Colonel Charles W. Gollehon of Fremont, Nebraska, has succeeded Colonel Neil O. Wilson (retired) as Chief Veterinarian of the First U. S. Army, headquarters of which are at Governors Island, New York.

His many duties as First Army Veterinarian will be staff responsibility for inspection of food supplies, sanitary inspections, control of animal diseases, planning for emergency and disasters, and training of personnel for these many responsibilities.

BECOMES DEAN OF DENTAL COLLEGE

Colonel Lowell E. MCKelvey, who recently retired from the Army Dental Corps, has become Dean of the Dental College of the University of Puerto Rico and its professor of oral surgery. He had been on duty at Brooke General Hospital.

While on duty in Puerto Rico from 1951-1954, he served as advisor on education to the committee which drew up the island's first permanent dental law establishing the same educational requirements for dentists as in the United States.

ASSIGNED TO FIFTH ARMY

Lt. Colonel Wiley H. Horn, VC, USA, has been assigned to the Fifth Army as Commanding Officer of its Veterinary Food Inspection Service at Chicago.

TO OKINAWA

Colonel Edward H. Vogel, Jr., who has been commander of the Surgical Research Unit at Brooke Army Medical Center since April 1957 has been transferred to the Army Hospital in Okinawa as Chief of Surgery. His successor is Lt. Colonel John A. Moncrief.

The Surgical Research Unit has done some very extensive research in the treatment of burns and has accumulated data on 1118 such cases. Many of these cases were flown to the Brooke Medical Center to take advantage of the skill that has been developed there.

COURSES IN NURSING

Two courses (Medical Nursing, January 29-February 2, 1962) and (Surgical Nursing, February 26-March 2, 1962) have been announced by the Army to be given at the Walter Reed Army Institute of Research, Washington, D.C.

Both Regular and Reserve officers of the Army Nurse Corps are eligible to attend. Application should be made to the Surgeon General of the Army.

NEW FILM

The Army Health Nurse (TF 8-3056) which portrays the role of the Army health nurse in a military community, is a 25 minute film patterned not only for the Army but for students in civilian schools of nursing, and civilian nursing and hospital organizations and agencies.

The film is available for loan through the Army Area Film and Equipment Exchanges.

LABORATORY TECHNICIAN COURSES

Army medical laboratory technicians with a military occupational specialty of 931.1 and additional qualifying experience may now apply for the advanced course for medical laboratory technician which will be given at the Armed Forces Institute of Pathology, Washington; Letterman General Hospital,

San Francisco; and Brooke General Hospital, Fort Sam Houston, Texas.

Training will be for 50 weeks. Applications should be made to the Surgeon General of the Army.

JOINS MULTIPLE SCLEROSIS SOCIETY

Colonel James Q. Simmons, Jr., recently retired First U. S. Army Surgeon, has been appointed Associate Medical and Research Director of the National Multiple Sclerosis Society.

Headquarters for the National Multiple Sclerosis Society are at 257 Park Avenue South, New York, 10, N. Y.

RETIRED

Colonel George H. Zacherle, Jr., VC, recently retired, was awarded the Army Commendation Medal by Lt. General Emerson L. Cummings, Commanding General of the Fifth Army. Attending the presentation were the Fifth Army Chief Veterinarian, Colonel William E. Jennings, and the Fifth Army Surgeon, Colonel Sterrett E. Dietrich.

FT. MEADE HOSPITAL

The recently dedicated hospital of the Army at Ft. Meade, Maryland, has been named the Kimbrough U. S. Army Hospital in honor of the late Colonel James C. Kimbrough, prominent urologist of the Army.

The principal speaker at the dedication ceremony was Lt. General Leonard D. Heaton, Surgeon General of the Army.

HELICOPTERS AND HELIPORTS

Since the Korean Conflict the value of the helicopter in the evacuation of the sick and wounded has become more and more important.

The helicopter ambulance, one of the newer type helicopters, provides space for patients inside the cabin.

The Army's first heliport designed specifically for the use of the helicopter ambulances was dedicated at Brooke Army Medical Center recently. Cost was somewhat more than $400,000. Besides the landing pad there is a large hangar with administrative and operations offices. Radio equipment and instruments for weather observation are provided. Rotary wing and fixed wing Link Trainers are being installed for a continuing program of pilot training.

BRIG. GEN. FRANK E. WILSON, Commanding General, 805th Hospital Center, pilot and nurse inspect a helicopter ambulance.

Navy

Surgeon General—REAR ADM. EDWARD C. KENNEY

Deputy Surg. Gen.—REAR ADM. ALLAN S. CHRISMAN

NEW ASSIGNMENTS

Rear Admiral C. G. Clegg, MC, as Commanding Officer, U. S. Naval Hospital Great Lakes, Ill., and District Medical Officer, Com-9.

Captain D. W. Boone, MC, as Commanding Officer, U. S. Naval Hospital, Charleston, S.C.

Captain R. O. Canada, MC, as Commanding Officer, U. S. Naval Hospital, Jacksonville, Florida.

Captain J. G. Feder, MC, as Commanding Officer, U. S. Naval Hospital, Portsmouth, N.H.

Captain G. M. Kahn, MC, Commanding Officer, U. S. Naval Hospital, Memphis, Tenn.

Captain M. C. Krepela, MC, as Commanding Officer, U. S. Naval Hospital, Guantanamo Bay, Cuba.

BUMED ASSIGNMENTS

Captain Malcolm W. Arnold, MC, USN, Ret., as Director of Publications Division and Editor of U. S. Navy Medical Newsletter.

Captain Donald R. Childs, MC, as Medical Member, Physical Review Council.

Captain George W. Russell, MC, as Head, Surgery Branch Professional Division.

Lieutenant Commander Charles U. Shilling, MC, for duty in Active Duty and Disposition Branch of Physical Qualifications and Medical Records Division.

RETIRED

Medical Corps Officers recently retired: Captains J. B. Butler, A. J. Cerny, M.K. Cureton, L. D. Ekvall, C. G. Grazier, G. R. Johnston, R. M. McComes, H. C. Oard, G. B. T. Ribble, C. P. Jeffers, E. Rollins, A. H. Staderman, V. C. Stratton, F. Weddell, W. L. Engelman.

Medical Service Corps Officers: Commander Daryl A. Wade; Lieutenant Commanders Roy F. Creech, Donald E. Fenquay, Daniel L. Kelly, Bernard J. Pfau, Walter C. Merrell, Charles I. McIntosh, James F. Rentz, Arthur L. Rogers, Raymond A. Weger.

NATIONAL NAVAL MEDICAL CENTER NEWS

Captain John S. Shaver, MC, a graduate of the University of Texas School of Medicine, has assumed command of the U. S. Naval Medical School. He succeeded Captain Malcolm W. Arnold who recently retired but has been called back to active duty with the Bureau of Medicine and Surgery.

Captain John R. Seal, MC, who has just returned from Cairo, Egypt, where he was Commanding Officer of the Naval Medical Research Unit No. 3, has assumed command of the Naval Medical Research Unit, NNMC, Bethesda.

Commander Paul L. Austin, MSC, is the new commanding officer of the U. S. Naval School of Hospital Administration. He succeeded Commander Calvin F. Johnson, MSC, who has become Administrative Officer at the School of Aviation Medicine, U. S. Naval Aviation Medical Center, Pensacola, Fla.

DASA PHYSICIAN PROMOTED

Dr. Clinton J. McGrew, Jr., Medical Division, Defense Atomic Support Agency, was recently promoted to Lieutenant Commander. After his internship in the Navy he specialized in Submarine Medicine. He has had two assignments on nuclear submarines.

TO WASHINGTON

Dr. Lloyd R. Newhouser, Captain, U. S. Navy Medical Corps, retired, has returned from Florida to Washington and is now Deputy Director of the Red Cross Blood Program. This is no new field to Dr. Newhouser as he held important positions in the World War II blood programs and since that time has been connected with such programs in military and civilian capacities.

PUBLICATIONS AND FILMS FOR TRAINING

Medical units, particularly surgical, that are interested in stepping up their training can well follow the advice of Surgical Team #3 from the Naval Hospital, Bethesda.

Teams should familiarize themselves with the following books and films:

1. Emergency War Surgery, NavMed P-5059
2. Landing Force Manual, Medical Service, U. S. Marine Corps
3. Series of Medical Department, U. S. Army on Surgery in World War II; particularly (a) Volume II-General Surgery, (b) Orthopedic Surgery—Mediterranean Theater of Operation.
4. Recent Advances in Medicine and Surgery based on Professional Experiences in Japan and Korea (Published by Walter Reed Army Medical Center, Vols. I, II
5. NavMed P-5046—Early Medical Management of Mass Casualties in Nuclear Warfare
6. NavPers 10819A—Combat and Field Medicine Practice

PMF 5304—Debridement of Wounds (Part I)

PMF 5305—Debridement of Wounds (Part II)
TF-8-2918—Resuscitation of Severely Wounded
TF-8-2676—Management of Mechanical Injuries in Mass Casualities
MN-7469—Cricothyroidotomy. Treatment of Thoracic Injuries (American Cyanamid)

Air Force

Surgeon General—MAJ. GEN. OLIVER K. NIESS
Deputy Surg. Gen.—MAJ. GEN. RICHARD L. BOHANNON

PROMOTED

Brig. General Don S. Wenger, USAF, MC, was promoted to that rank as of August 1. He is Chief of the Consultants Division, Office of the Surgeon General of the Air Force, Washington.

ASSIGNMENTS

Colonel Thaddeus J. Domanski, to Armed Forces Institute of Pathology, Washington, D.C.

Major Elmer V. Dahl, as Commander of the 3790th Epidemiological Laboratory, Lackland Air Force Base, Texas.

BREATHE PURE OXYGEN

Seventeen days of breathing pure oxygen in a space cabin simulator at the simulated height of 33,500 feet, brought no ill effects to two Air Force officers, Captains Louis C. Gang and Bernard L. Westfall. The experiment was conducted at the USAF Aerospace Medical Center, Brooks Air Force Base, Texas.

Throughout the 17 days, the pilots lived on dehydrated food and water that was obtained by recycling and purifying. They manned the cabin's performance panel 20 hours a day in shifts varying from two to five hours in length.

According to Dr. Billy E. Welch, Chief of the Department of Space Medicine's Space Ecology Branch, there is no need to worry about carrying along an inert gas such as nitrogen.

VIG

Vaccinia immune globulin (VIG) was first discovered about eight years ago by Dr. C. H. Kempe, Professor of Pediatrics, University of Colorado. This globulin is used in cases of severe reaction to smallpox vaccine, and must be obtained from the blood of persons vaccinated against smallpox twenty-eight days prior to the donation of the blood. Recently 2000 airmen at Lackland Air Force Base, Texas, donated some 250 gallons of blood. They were Air Force recruits who had received a positive reaction to the smallpox vaccination given them 28 days before.

About 3000 units of VIG, enough for the entire United States for a year, was provided from the 250 gallons of blood.

This program is a joint one with the Air Force and the American Red Cross.

Public Health Service

Surgeon General—LUTHER L. TERRY, M.D.
Deputy Surg. Gen.—JOHN D. PORTERFIELD

POLIOMYELITIS

In the first 32 weeks of this year there were 270 cases of paralytic poliomyelitis recorded. In the same period of 1960 there were 777 cases.

HEPATITIS

Infectious and serum hepatitis tor the first 32 weeks of 1961 numbered 49,739 as against 23,400 for the like period of 1960.

VENEREAL DISEASE

With the increasing rate of venereal disease the Public Health Service is taking steps to combat these diseases.

The 19,000 cases of infectious syphilis reported in the United States during the fiscal year which ended June 30 was the greatest number of infectious syphilis cases reported in any year since 1950.

A task force headed by Dr. Leona Baum-

gartner, Commissioner of Health for New York City, plans to meet there on September 13. Serving with Dr. Baumgartner will be Dr. Arthur C. Curtis, Professor and Chairman, Department of Dermatology and Syphilology, University of Michigan Hospital; Dr. Archie L. Gray, Executive Officer, Mississippi State Board of Health; Benno E. Kuechle, retired Insurance Executive from Wausau, Wisconsin; and T. Lefoy Richman, Projects Coordinator for the National Commission on Community Health Services, New York.

INTERAGENCY INSTITUTE

The time will come when every hospital, large or small, will have a well planned research program, Dr. Luther L. Terry predicted in a talk at the concluding session of the 18th Interagency Institute for Federal Hospital Administrators, held recently.

The Surgeon General of the Public Health Service said a research environment contributes enormously to other aspects of hospital service, by benefiting the patients, by raising the prestige of the hospital, and by stimulating the staff. He urged Federal hospital administrators to encourage and aid in the development of research programs, and expressed the opinion that many young men and women on their staffs would welcome the opportunity to engage in clinical or administrative studies.

The Public Health Service sponsored the institute, which was attended by 28 persons from PHS, Veterans Administration, and Army hospitals in 17 States and a representative of the Department of Veterans Affairs of Canada. The 22 faculty members were from universities, hospitals, and organizations. The course lasted three weeks.

These institutes are held twice each year, under direction of Frederick H. Gibbs, professor of hospital administration at George Washington University, Washington, D.C. The next one is scheduled for January 8-26.

COURSE AVAILABLE

Applied Epidemiology, Course No. 112, will be given at the Communicable Disease Center, Atlanta, Georgia, October 30-November 3.

Applications for the course must be received at the Center by October 2, Attention: Chief, Training Branch.

RADIOLOGICAL HEALTH RESEARCH GRANTS

For those interested in research in radiological health, whether physicians, engineers, physicists, or chemists, and who can present a problem for study, a research grant may be available. For further information write to Dr. Paul F. Hahn, Chief, Office of Extramural Grants, Divison of Radiological Health, U. S. Public Health Service, Washington 25, D.C.

RETIRED

Dr. Harry Eagle, who has been Chief of the Laboratory of Cell Biology, National Institutes of Health, has retired from the Public Health Service. He has joined the Albert Einstein College of Medicine, New York, where he will be Chairman of the Department of Cell Biology.

His early work in syphilology produced many contributions to scientific literature as well as the serologic test which bears his name.

FILMS

The Filariasis Story in India (F-449) is a 35 mm, color, silent, film strip with 276 frames for entomologists, parasitologists, clinicians, and public health workers.

Space Spraying of Insecticides (M-442), is a 16 mm, color, sound, 11-minute film for sanitarians and pest control operators.

These can be obtained on a short-term loan from the Communicable Disease Center, USPHS, Atlanta 22, Georgia.

PUBLICATION

Parkinson's Disease—Hope Through Research (PHS Publ. No. 811) is a pamphlet for the victims and their families. This is an excellent pamphlet to put in their hands and will answer many of the questions they may have. Copies may be obtained from the Pub-

lic Health Service or in quantities from the Government printing office (15¢ each for orders under 100).

BIBLIOGRAPHY

Pulmonary Mycotic Infections, a bibliography of literature 1957-April 1961, is available at the National Library of Medicine, Washington. This was compiled by Dorothy Bocker, M.D., and contains 28 pages of valuable references on the subject.

HEART RESEARCH NEWS

A "from time to time" pamphlet is published by Heart Information Center, National Institutes of Health, Bethesda 14, Maryland, for lay readers. Copies may be procured on request to that Center.

Veterans Administration

Chief Medical Director—WILLIAM S. MIDDLETON, M.D.

Deputy Chief Med. Dir.—H. MARTIN ENGLE, M.D.

APPOINTMENT

Dr. Robert E. Riederer, a graduate of the University of Kansas Medical School, was recently appointed Chief of Professional Training in the Education Service of the Veterans Administration. He has been in private practice in Olathe, Kansas, since 1946. During World War II he served with the Navy.

HONORED

Dr. William H. Feldman, Chief of Laboratory Research in pulmonary diseases, Veterans Administration, Washington, has been elected an honorary member of the Section of Comparative Medicine of the Royal Society of Medicine, London. This is the highest honor that the section can bestow.

Dr. Feldman holds the degrees of doctor of veterinary medicine and doctor of science. Before joining the Veterans Administration in 1957 he was on the staff of the Mayo Clinic for 30 years.

Miscellaneous

HOROWITZ LECTURES 1960

The Institute of Physical Medicine and Rehabilitation of New York University Medical Center has announced the publication of Rehabilitation Monograph XVIII, "The Horowitz Lectures, 1960," by Wing Commander C. B. Wynn Parry, MB.E., M.A., D.M., M.R.C.P., D.Phys.Med. He is Principal Specialist in Physical Medicine to the Royal Air Force and is in charge of electromyography at the London Hospital, Whitechapel.

The Monograph may be ordered for $1 from the Institute of Physical Medicine and Rehabilitation, 400 East 34th St., New York 16, N.Y.

CASE FOR DIAGNOSIS

(See page 707.)

Pathologic diagnosis: Renal cell carcinoma, left kidney, with invasion of renal vein.

Subsequent course: Nineteen months later the patient was hospitalized with metastases to the thoracic vertebrae.

BLOOD VOLUME MACHINE

Two University of Chicago scientists have developed a machine to accurately measure the speed and volume and blood flow, without opening a blood vessel for these measurements. They are Dr. Walter Feder, Assistant Professor in the Department of Medicine, and Dr. Emmett B. Bay, Professor in the same department.

AUTOMATIC BLOOD PRESSURE RECORDING

An automatic blood pressure recording system, originally developed for Project Mercury, will be available to hospitals and physicians.

This system will measure both the systolic and diastolic pressure levels at any desired frequency and can be recorded on tape for later study.

Especially designed for Project Mercury, the astronaut's blood pressure will be taken every 30 minutes for 6 minutes. This information will be telemetered to the ground.

For the hospital the device becomes especially useful in that pre-set limits will quickly call attention of the staff to any undue rise or fall.

DRUG MANUFACTURERS IN RESEARCH

A record $206.5 million investment in research was made last year by drug manufacturers in search of new drugs. It expected that in 1961 the figure will rise to $227 million. About 7.7% of the income is spent in research.

FILM

The Diagnosis of Viral Meningitis is a 16 mm, color, sound film, running time—35 minutes. The film was prepared by the University of Kansas Medical Center and the Kansas City Field Station Unit of the U. S. Public Health Service.

The film may be borrowed from The National Foundation (Professional Education Announcement), 800 Second Avenue, New York 17, N.Y.

MEETINGS

The American College of Chest Physicians will hold an Interim Session in Denver, Colorado, November 25-26. Further information may be obtained from the Executive Director, 112 East Chestnut St., Chicago 11, Ill.

The First Inter-American Conference on Congenital Defects, sponsored by The National Foundation and The University of Southern California, will be held in Los Angeles, January 22-24, 1962. Further information may be obtained from the Executive Secretary, International Medical Congress, Ltd., 120 Broadway (Room 3013), New York 5, N.Y.

PAMPHLET

You and Your Hearing is a 20-page pamphlet (No. 315) written by a physician for the non-professional reader. Copies may be obtained from Public Affairs Pamphlets, 22 East 38th St., New York 16, N.Y. for 25¢ a copy.

PUBLICATION

Health, Education, and Welfare Trends is a 136 page statistical digest which covers 103 subjects dealing with the health, education, and welfare of the American people. It includes facts about school enrollment; Federal grants-in-aid; medical care costs; health facilities; personal income; and child health and welfare.

Here are some facts cited in *Trends:*

Births continued at a near record of 4.3 million.

The illegitimate birth rate per thousand unmarried women aged 15-44 tripled from 7.0 in 1938 to 21.0 in 1958.

A far higher proportion of students are going on to college—over 30 percent in recent years as compared with 12 percent in 1931.

At the end of 1960, 25 years after the initiation of the social security system, there were 14.8 million beneficiaries under the Old-Age, Survivors, and Disability Insurance program.

Copies of HEW *Trends* may be obtained from the U. S. Government Printing Office at $1.00 per copy.

WHO PUBLICATIONS

Gonorrhea—Treatment Problems. Bull. V24/3/61. $2.00.

World Directory of VD Treatment. Centers at Ports. $1.75.

Ionizing Radiation and Health. Pub. Health Pap. #6. $1.00.

Basic Nursing Education Programs. Publ. #Health Pap. #7. $1.00.

Arthropod-Borne Viruses TR #210/61. $1.00.

Pharmaceutical Advertising. Survey/61. .60.

Tbc Control Cor pulmonale, Bilharziasis. Chron V.15/5-6/61. .60.

Standardization of Methods for Conducting Microbic Sensitivity Tests. TR No. 210/61. .30.

The Use and Training of Auxiliary Personnel in Medicine, Nursing, Midwifery and Sanitation. TR No. 212/61. .30.

Periodontal Disease—A Report of Expert Comm. TR No. 207/61. .60.

Aircraft Disinfection, 11th Report on Insecticides. TR No. 206/61. .30.
Chronic Cor Pulmonale, Report of Expert Comm. TR 213/61. .30.
The Teaching of the Basic Medical Sciences in the Light of Modern Medicine. TR 209/61. .30.
European Standards for Drinking Water (English and French). .60.
Planning of Public Health Services. (TRS No. 215/61. .60.
Molluscicides. TRS No. 214/61. 60.
Requirements for Schools of Public Health. TRS No. 216/61.
Health Statistics 1948-1958. Gear et al./61. .60
Poliomyelitis. 3rd Report of Comm. TR #203/60. .60.
Low Birth Weight. TR #217/61. .30.
Health Statistics. TR #218/61. .30.
Chagos' Disease. TR #202/60. .30.

Above may be obtained from Columbia University Press, IDS, 2960 Broadway, New York 27, N.Y.

Honor Roll

Since the publication of our last list, the following sponsored one or more applicants for membership in the Association:

Lt. Col. H. W. Merrill, MC
Lt. Col. Leonard D. McLin
Maj. Gen. O. K. Niess, Surg. Gen. USAF
Capt. Murray Ross, DC, USAF
Phar. Dir. George F. Archambault, USPHS
Capt. E. E. Hunsuck, DC, USA
Lt. Col. William Stein, USA
Lt. Col. Edw. A. Barrett, MC, USAR
Cdr. Helen Samonski, NC, USN
CDR Calvin F. Johnson, MSC, USN
Vernon O. Smith, M.D.
Rear Admiral Richard A. Kern

New Members

Lt. H. Ronald Racki, MSC, USA
Col. Fredrick J. Haase, MSC, USA
Lt. Col. Hernando Rubiano-Groot, Colombian Army, MC
Lt. Robert Gerson, MSC, USA
Phar. Dir. Boyd W. Stephenson, USPHS
LCDR Henry H. Bloom, MC, USN
Lt. W. E. Arns, MSC, USN
Maj. Gen. Richard L. Bohannon, MC, USAF
Capt. John M. Hess, USAF, MC
Major Raymond C. Haley, Jr., MC, Fla. Army National Guard
Surg. James C. Mann, USPHS-R
Capt. Norman Arthur Bomengen, Medical Officer, C.A.P.
Lt. Col. Suzanne Marie Ottoy, USAF, NC
Capt. Joseph H. Kolodney, DC, USAF
Lt. Robert Lee Woodward, MSC, USAF
Lt. Kenneth D. Mayfield, MSC, USN
Lt. Betty M. Stokely, NC, USN
Capt. Barbara E. Lane, ANC
Lt. Roland G. Peaslee, MSC, USAR

MEMBERSHIP COMMITTEE

Lt. Col. Nathan Cooper, U. S. Air Force, MSC, Chairman
Mr. George F. Archambault, USPHS
Commander Burdette M. Blaska, NC, USN
Colonel Jesse W. Brumfield, MSC, U. S. Army
Lt. Col. V. Harry Adrounie, USAF, MSC
Mr. Vernon O. Trygstad, Veterans Administration
Lt. Col. Carl J. Schopfer, MC, NJNG

Death

HEWITT, Reuel E., Colonel, Medical Corps, U. S. Army, Retired, died June 10 at Auburn, California, at the age of 59.

Colonel Hewitt, a native of Iowa, received his medical degree from the University of Iowa in 1925 and entered military service shortly after graduation. He was a graduate of the Army Medical School and the Medical Field Service School and the Army Industrial College. He specialized in medical supply. In 1947 he was Surgeon of the First Army Corps in Japan and the year following Surgeon of the Eighth Army.

He is survived by his widow, Marguerite, P.O. Box 192, Auburn, California, and three daughters.

Interment was at the National Cemetery, Presidio, San Francisco.

NEW BOOKS

Oakes' Dictionary for Nurses. 11th Edition. Compiled by Nancy Roper, S.R.N., R.S.C.N., S.T.D. (Lond.). 492 pp. The Williams & Wilkins Co., Baltimore, exclusive U.S. agents. Price $2.75.

Ciba Foundation Study Group No. 7 *Virus Meningo-Encephalitis.* Editors: G. E. W. Wolstenholme, O.B.E., M.A., M.B., M.R.C.P. and Margaret P. Cameron, M.A. 120 pp., illustrated. Little, Brown and Company, Boston. Price not stated.

Ciba Foundation Symposium. *Quinones in Electron Transport.* Editors: G. E. W. Wolstenholme, O.B.E., M.A., M.B., M.R.C.P. and Cecilia M. O'Connor, B.Sc. 453 pp, 82 illustrations. Little, Brown and Company, Boston. Price $11.00.

Emotional Factors in Public Health Nursing. Compiled by the Bureau of Maternal and Child Health of the Wisconsin State Board of Health. Edited by Abraham B. Abramovitz. With a Foreword by Ione Rowley, R.N. University of Wisconsin Press, Madison, Wisconsin. Price not stated.

Psychiatry Vol. I: Principles. (Personology; General Psychiatry.) By E. Eduardo Krapf, M.D., Chief, Mental Health, WHO. 244 pp., illustrated. Grune & Stratton, New York, London. Price $6.50.

Current Psychiatric Therapies. Vol. I, 1961. Edited by Jules H. Masserman, M.D. 246 pp. Grune & Stratton, New York, London. Price $7.50.

Clinical Diagnosis by Laboratory Examinations. 3rd Edition. By John A. Kolmer, M.S., M.D., Dr.P.H., Sc.D., LL.D., F.A.C.P., F.A.C.D. (Hon.). 543 pp., illustrated. Appleton-Century-Crofts, Inc., New York. Price $10.00.

Clinical Orthopaedics, No. 19: *Soft Tissue Tumors.* Anthony F. DePalma, Editor-in-Chief. 307 pp., illustrated. J. B. Lippincott Company, Philadelphia, Montreal. Price $7.50.

Hypertension—Chemical and Hormonal Factors. Vol. IX. Proceedings of the Council for High Blood Pressure Research, American Heart Association, Nov. 1960. Edited by Floyd R. Skelton. M.D., Ph.D. 806 pp., illustrated. American Heart Association, Inc., New York. Price $2.50.

A Manual For Nuclear Medicine. By E. R. King, Capt., MC, USN and T. G. Mitchell, Lt., MSC, USN. With Foreword by B. W. Hogan, Rear Admiral, MC, USN, Surgeon General of the Navy. 406 pp., illustrated. Charles C Thomas, Springfield, Ill. Price $13.50.

Relief of Symptoms. 2nd edition. By Walter Modell, M.D., F.A.C.P. 374 pp. The C. V. Mosby Company. St. Louis. Price $11.50.

Proceedings of The Fourth National Cancer Conference. University of Minnesota, Minneapolis, Minnesota, Sept. 13-15, 1960. Sponsored by American Cancer Society, Inc. and National Cancer Institute, U.S. Public Health Service. Co-chairmen: Harry M. Nelson, M.D., Director-at-Large, American Cancer Society, and Michael B. Shimkin, M.D., Associate Director for Field Studies, National Cancer Institute. 774 pp., illustrated. J. B. Lippincott Company, Philadelphia, Montreal. Price $9.00.

The Adrenal Cortex. Chemical Pathology in Relation to Clinical Medicine. The Proceedings of a Symposium organised by the Association of Clinical Pathologists held in London at the Royal Society of Medicine, October 14-15, 1960. Edited by G. K. McGowan and M. Sandler. Chairman: Prof. C. H. Gray, King's College Hospital Medical School, London. 226 pp., illustrated. J. B. Lippincott Company, Philadelphia, Montreal. Price $5.00.

Contemporary Psychotherapies. Edited by Morris I. Stein, Ph.D. With Ten contributors. 386 pp. The Free Press of Glencoe, New York. Price $7.50.

Management of Medical Emergencies. Edited by John C. Sharpe, M.D. With 18 contributors. 354 pp., illustrated. McGraw-Hill Book Company, Inc., New York. Price $9.75.

The Image of Love. Modern Trends in Psychiatric Thinking. By Clemens E. Benda, M.D. 206 pp. The Free Press of Glencoe, New York. Price $5.00.

Toward the Conquest of Cancer. By O. A. Battista. Sc.D. 137 pp. Chilton Company, Philadelphia. Price $3.95.

Progress in Clinical Medicine. 4th Edition. Edited by Raymond Daley, M.A., M.D. Cantab., F.R.C.P., and Henry Miller, M.D. Durh., F.R.C.P., D.P.M. With 10 contributors. 345 pp., illustrated. Little, Brown & Company, Boston. Price $12.50.

The Adolescent Society. The Social Life of the Teenager and its Impact on Education. By James S. Coleman. With the assistance of John W. C. Johnstone and Kurt Jonassohn. 368 pp. The Free Press of Glencoe, New York. Price $6.95.

Biochemists' Handbook. Compiled by 171 contributors. Edited by Cyril Long, M.A., B.Sc., D.Phil., F.R.S.E. Consultant Editors: Earl J. King,

Ph.D., D.Sc., F.R.I.C. and Warren M. Sperry, Ph.D. 1192 pp., illustrated. D. Van Nostrand Company Inc., Princeton, N.J. Price $25.00.

Collected Papers of the Mayo Clinic and the Mayo Foundation. Vol. 52—1960. Compiled by George G. Stilwell, A.B., M.D. 868 pp., illustrated. W. B. Saunders Company, Philadelphia, London. Price $15.00.

Stedman's Medical Dictionary. 20th Edition; completely revised. 1680 pp., illustrated. The Williams & Wilkins Company, Baltimore. Price $14.95.

What Teenagers Want to Know. By Florence Levinsohn, B.A., M.A., in consultation with G. Lombard Kelly, A.B., B.S.M., M.D. 89 pp., illustrated. Budlong Press Co., Chicago. Price $1.50.

Clinical Endocrinology. For Practitioners and Students. 3rd Edition. By Laurence Martin, M.D. (Camb.), F.R.C.P. (Lond.). 275 pp., illustrated. Little, Brown & Company, Boston. Price $8.00.

ESSAY CONTEST

(U. S. Naval Institute, Annapolis, Md.)

Anyone may enter contest, civilian or military. A prize of not more than $1500, a gold medal, and a Life Membership in the Naval Institute is awarded to the winner.

Subject: Any subject that contributes toward mission of Naval Institute—"the advancement of professional, literary, and scientific knowledge in Navy." Essay should be analytical or interpretive and not merely an exposition or personal narrative.

Essay: Must have a title and a motto underneath title. Omit name of author. Not more than 5000 words. Must be typewritten, double spaced, on one side of paper (8½" x 11"), in duplicate.

Author: Omit name on essay. Use motto under title. Enclose envelope with title of essay and motto on outside; inside enclose sheet of paper with title, motto, and name of author and address. Envelope to be sealed.

Mailing: Mail in large sealed envelope to Secretary-Treasurer, U. S. Naval Institute, Annapolis, Md., no later than November 1, 1961.

INFORMATION FOR AUTHORS

COPYRIGHT: Matter appearing in MILITARY MEDICINE, the official journal of The Association of Military Surgeons of the United States, is covered by copyright. Permission must be obtained for the reproduction of anything in the columns of MILITARY MEDICINE.

MANUSCRIPTS: Manuscripts, including references, should be typewritten, double-spaced, on one side of unruled paper, size 8½ × 11 inches (approximately); original should be sent, carbon copy should be retained by the author. The author's name, official title, and address should be clearly stated. Photographs must be clear glossy prints, in black and white, unmounted, and properly identified. A limited number of illustrations will be reproduced at no expense to the author. Legends should be typed on a separate sheet of paper, numbered, and attached to each illustration; these should be numbered consecutively and location stated in the text. Quotations must include full credit to both author and source. Bibliographic references should be kept to a minimum. While manuscripts are subject to editing, the author assumes the responsibility for the statements he makes. It is understood that a manuscript accepted for publication will appear only in MILITARY MEDICINE.

REPRINTS: Reprints must be ordered when galley proof is returned by the author to the editor.

ADDRESS: Send manuscripts to the Editor, MILITARY MEDICINE, Suite 718, 1726 Eye Street, N.W., Washington 6, D.C.

BOOK REVIEWS

Cell Physiology of Neoplasia. A Collection of Papers Presented at the Fourteenth Annual Symposium on Fundamental Cancer Research, 1960. Published for The University of Texas M.D. Anderson Hospital and Tumor Institute. 653 pp., illust. University of Texas Press, Austin. Price $10.50.

This is the fourth monograph in the series which has developed from the Annual Symposiums on Fundamental Cancer Research held at the M. D. Anderson Hospital and Tumor Institute in Houston. It includes twenty papers by scientists from England, Sweden and the United States. The theme of the monograph is the physiology of neoplastic cells and papers are divided into four groups. One group pertains to the nucleus and includes papers on chromosomes, nucleoli and the nuclear envelope. Another group is devoted to the cytoplasm and includes discussions of the Golgi complex, cell constituents in tumors of viral origin, enzyme localization in tumor cells and relationships between nucleus and cytoplasm in normal and malignant growth. The third group comprises papers on nucleic acids with discussions on deoxyribonucleic acid variations in neoplastic and virus infected cells; studies on the structure, composition and metabolism of tumor ribonucleic acid; the biochemistry of ribonucleotides and ribonucleic acid in normal and malignant cells, and the biological activity of ribonucleic acids of viral origin. The fourth group is devoted to cell growth and cell development with papers on enzyme behavior in carcinogenesis; nuclear physiology in carcinoma; growth and chromosome studies of drug resistant lines of cells in tissue culture; duplication of chromosomes and related events in the cell cycle; mitosis and cytodifferentiation, and transplantation studies as related to developmental potentialities of the cancer cell nucleus.

The authors are well versed in their particular fields and the subject matter is well presented. Discussions at the end of each chapter add interest to the volume.

This collection of papers will be of particular interest to the individual interested in research in the field of physiology of cancer cells. It is not for the casual reader but for those whose training has been in this field.

Col. Hugh R. Gilmore, Jr., MC, USA, Ret.

Cardiac Emergencies and Related Disorders. Their Mechanism, Recognition and Management. By Harold D. Levine, M.D. 381 pp., illust. Landsberger Medical Books, Inc., New York. Price $12.00.

In this volume of convenient size and easy readability, Dr. Levine presents the material which has been of most value to him in the management of cardiac emergencies and related disorders. What he has written is not new nor is it meant to be, but it is orderly, brief and of a practical nature. Much of it is opinion and drawn from personal experience. It is not intended to be a theoretical text but rather a helpful reference for the physician who must act now in life-threatening situations. Many suggestions and refinements of techniques for bedside use appear in every chapter.

Non-cardiac causes of chest pain, digitalis intoxication, and cardiac arrest are dealt with in their individual chapters in a thoroughly helpful manner. Heart failure, myocardial infarction, pulmonary embolism and the arrythmias are reviewed in sufficient detail.

Those who demand exactness of terminology in medical writing may object to the author's use of some phrases, such as "merc sandwich" or "prime the pump." Actually, however, these terms lend to the informality of the text and allow the reader to feel as if Dr. Levine is talking with him about his experience in a personal discussion.

A philosophy for the management of cardiac arrest, as well as other emergencies, reveals the maturity of the author and could be very helpful to house staff and younger practitioners.

Clear photographs, electrocardiographic tracings and adequate bibliographies supplement the various topics.

This book will be especially helpful to those physicians who do not see large numbers of cardiac problems daily but who do meet cardiac emergencies in their practice.

Henry L. Hook, M.D.

Clinical Pharmacology. By D. R. Laurence, M.D., M.R.C.P., and R. Moulton, M.B. 490 pp. Little, Brown and Company, Boston. Price $10.00.

This book is written primarily for medical students in their clinical years but is of great value for practitioners of medicine and surgery. The authors are from the Pharmacology Department of the University College Hospital Medical School in London. They entered many references from British and American journals and texts at the end of each chapter.

The authors contend that most books in this field

either stress the pharmacology of drugs without information on their selection or effective use; or stress practical therapy without pharmacological aspects of the drugs. This compact, concise work presents in 29 chapters an excellent blending of materia medica and therapeutics. The headings include "Development of New Drugs, Therapeutic Trials"; "Chemotherapy of Individual Diseases"; "Corticotrophin, Adrenocortical Hormones"; "Hypnotics, Sedatives, Anticonvulsants"; "Anesthetics, Neuromuscular Blocking Agents, Local Analgesics"; "Sympathomimetics"; "Vitamin K and Anticoagulants"; "Nucleotoxic Drugs" and "General Pharmacology, Unwanted Effects of Drugs."

All physicians are encouraged to consider the following factors when contemplating drug therapy: (a) whether to use a certain drug; (b) what alterations may be expected in the patient; (c) will the prescribed drug do what is desired; and (d) what other effects may occur and are they harmful. One of our big problems in evaluating drugs is allowing clinical impressions to outweigh scientific facts of our studies. I recommend this text for young physicians and others who desire to use drugs more effectively and economically for their patients.

COL. U. ROBERT MERIKANGAS, USA, RET.

MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS. 7th Ed. By H. Earle Conwell, M.D., F.A.C.S. and Fred C. Reynolds, M.D. 1153 pp., 1227 figs. The C. V. Mosby Co., St. Louis. Price $27.00.

This classic on the management of fractures, dislocations and sprains is now co-authored by Dr. Fred C. Reynolds, an associate and now successor of the late Dr. J. Albert Key as Professor of Orthopaedic Surgery at Washington University School of Medicine.

This edition has been completely revised. Although the general format remains the same, much that was repetitious and obsolete has been deleted. It maintains its clear, easy to read style as it covers general principles of fracture repair, treatment and complications. The sound management of specific fractures and dislocations are thoroughly covered for each region of the body. Included is a chapter on fractures of the jaws and related bones of the face. The chapter on injuries to the hand is noteworthy in its revision. The text is adequately illustrated by use of many of the old figures and by the addition of many new ones.

COL. JOSEPH W. BATCH, MC, USA

RESUSCITATION OF THE NEWBORN INFANT. Principles and Practice. Edited by Harold Abramson, M.D., 24 contributors. 274 pp., illust. The C. V. Mosby Company, St. Louis. Price $10.00.

"This is the story of the resuscitation of newborn infants—what we know and what we do not know." These words preface this excellent book which has been so long anticipated by physicians charged with the care of newborns. It is the combined work of twenty-four contributors from basic science and clinical fields. These persons form the Special Committee on Infant Mortality of the Medical Society of New York. Their initial 46 page report, published in 1956, was extensively reprinted and widely circulated. It served as a standard for guidance ever since. Its tremendous reception stimulated the more detailed studies now reported in this book.

The manifold causes of anoxia are presented in tabular fashion and discussed. Analgesic or anesthetic agents used during delivery are carefully analyzed, describing effects on mother and fetus which may influence selection.

Infants have long been the helpless recipients of erroneous therapy, too much or too little resuscitative manipulation. In the chapters concerned with the infant's first minutes of life lies the most vital information in the book.

Sections follow on the infant's appraisal and care in the nursery. A new concept is introduced, the recovery nursery, where an infant in difficulty can receive intensive care until out of danger.

Since standard terminology is necessary to improve communication between obstetrician, pediatrician, anesthesiologist and research worker it is appropriate that a glossary of scientific terms is appended. Each chapter has a meticulously done bibliography substantiating almost every statement in the text. Selected black and white illustrations graphically point up important items. Author and subject indices make cross-referencing complete and easy.

The book ought to be required reading for every medical student, intern, or resident before his service in delivery room or newborn nursery.

MAJ. EDWARD J. TOMSOVIC, MC, USA

A SYNOPSIS OF CONTEMPORARY PSYCHIATRY. 2nd Ed. By George A. Ulett, B.A., M.S., Ph.D., M.D.; and D. Wells Goodrich, M.D. 309 pp. The C. V. Mosby Company, St. Louis. Price $6.50.

This book, small and durable enough to be carried in the pocket of a clinical coat, was written, according to the authors, "to fill the need for a brief introductory text of psychiatry as a quick reference for psychiatric residents, medical and psychological interns, medical students, nurses, and others whose work in the psychiatric clinic and hospital may be for a brief period of time." It contains a surprising amount of information on classification, etiology, diagnosis and treatment, much of which would not be subject to the ready recall of even more advanced students than those for whom the volume is intended. On the other hand, no psychiatric resident could proceed very far in any of his courses of

study without requiring considerably more data than he will find here. From this point of view it would probably be of more lasting value to students in allied specialties than to those in psychiatry.

In my opinion the presentation is balanced and on the whole the material is well selected and accurate. Criticisms are minor ones. As an example, some statistics are given in which the base is not adequately stated. To say that the incidence of schizophrenia in the general population is 0.7 to 0.9% (p. 123) is not very precise, and one must speculate whether this means prevalence or frequency of occurrence over some unspecified period of time.

On the whole this is a nice little volume and can be recommended for the purpose intended by the authors.

COL. WILLIAM H. ANDERSON, MC, USA

THE MANIPULATION OF HUMAN BEHAVIOR. Edited by Albert D. Biderman and Herbert Zimmer; 8 contributors. 323 pp. John Wiley & Sons, Inc., New York and London. Price $7.95.

This is obviously a source book for those research workers who are studying the possibilities of controlling or manipulating human behavior. It would be of prime interest to military personnel who have to do with interrogation and the understanding of so-called "brain washing." The two editors have carried out this project for the Bureau of Social Science Research, Inc., and the preparation of the chapters was supported in part by the United States Air Force. The book is comprised of seven original papers. Each contributor was chosen because of his previous work in a particular specialty which is the subject of his paper, and his familiarity with the extensive literature in this field.

Besides the seven chapters, there is an extensive introduction written by the two editors, in which they state: "In recent years, concern has been expressed, in both scholarly and popular literature, about the dangers of scientific developments that could be used to control and manipulate human behavior. The fear is frequently voiced that techniques have been developed to an extent which threatens fundamental values of Western civilization. Anxious alarms and dramatic speculations have overshadowed reports of sober efforts to determine which dangers are real and which imagined." The introduction, as well as each chapter, is followed by a list of references, so that anyone interested in this important subject will find references to almost every paper written on the subject. There are a total of 771 of these references.

There is an author index and a detailed subject index which makes this book a worthwhile volume for every medical military installation, as well as for practicing psychiatrists.

CDR. JAMES L. MCCARTNEY, MC, USNR, RET.

THE CHOICE OF A MEDICAL CAREER. Essays on the Fields of Medicine. Edited by Joseph Garland, M.D., Sc.D.; and Joseph Stokes III, M.D. 22 contributors. 231 pp. J. B. Lippincott Company, Philadelphia. Price $5.00.

For his own reasons a physician chooses a special area in the broad field of medicine. As time goes on he may feel that he has not chosen wisely. With much training behind him he can ill afford to duplicate that training in another field. While there are those in this category the fact remains that most physicians are satisfied with the choice they make.

For those who would know the problems in the various areas of medicine this book acts as his consultant and adviser. The 21 chapters cover the specialties. Each chapter is written by a distinguished physician speaking of his own area in medicine.

Here is sound advice well presented.

R.E.B.

WHAT A GIRL SHOULD KNOW ABOUT SEX. By Bernhardt S. Gottlieb, M.D. The Bobbs-Merrill Company, Inc., Indianapolis. Price $3.25.

The first thing one wants to know about a book on this topic is something about the author. From what experience does he speak?

Dr. Gottlieb has practiced medicine for forty years and is a psychiatrist with especial interest in the psychiatry of adolescence. He has served on the staff of many hospitals and taught in medical schools.

This book is not written to be sensational. It presents the problems of girls who are seeking knowledge on the perplexing sex facet of their lives and gives the answers without any emotionalism or religious reference.

Physicians have here a book that can be recommended to parents and their daughters to give them this education which is so urgently needed.

A.J.B.

ANATOMY AND PHYSIOLOGY FOR RADIOGRAPHERS. By C. K. Warrick, M.B., B.S., M.R.C.S., L.R.C.P., F.R.C.S., F.F.R., D.M.R. 265 pp., illust. The Williams & Wilkins Co., Baltimore, exclusive U. S. agents. Price $7.00.

Written in simple, easily read form, this book is adequate for x-ray technicians as well as other students who desire a brief and concise knowledge of human anatomy and physiology. It should be useful to radiologists who desire a brief text for lecture material to x-ray technicians.

Material on radiographic anatomy and the biological effects of radiation are included and add to the general usefulness and interest. Many excellent diagrams and x-rays are reproduced for further clarification.

This book is well written and well suits the purpose for which it was intended.

COL. JOHN A. ISHERWOOD, MC, USA